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A Calendar of Upcoming Events

December 5-7, 1975:
LA:2000 (A Science Fantasy Conference) at the International Hotel, Los Angeles, California. Sponsored by the Los Angeles Science Fantasy Society (founded October 1934) in honor of their 2000th meeting. Registration $3. Info: LASFS, 11360 Ventura Boulevard, Studio City, California 91604.

December 5-7, 1975:
HALF-A-CON (informal SF conference with emphasis on fantasy arts and Mardi Gras) at the International Hotel, New Orleans, Louisiana. Registration: $5; plus banquet, $10. Info: Box 8466, New Orleans, Louisiana 70182.

December 31, 1975:
Deadline for obtaining membership in Eurocon III to be held in Poznan, Poland August 1975. Registration: U.S. $10. Info: V. Brown, Pharmacy Department, University of Aston, Gosta Green, Birmingham B4 7ET, England; Peter Kuczka, Attila U. 35 H-1013 Budapest, Hungary; Pierre Versins, CH1463 Rovray, Switzerland. This will be the third European SF Convention.

April 16-19, 1976:
MANCON 5 (27th British SF Convention) at Owens Park, Manchester, England. Guest of Honor: Robert Silverberg; Fan Guest of Honor: Peter Roberts. Registration (North American): $6 attending, $2 supporting (from Bill Burns, 48 Lou Avenue, Kings Park, New York 11754). Info: Brian Robinson, 9 Linwood Grove, Longsight, Manchester, England.

September 1-6, 1976:
MIDAMERICON (34th World Science Fiction Convention) at Hotel Muehlbach, Kansas City, Missouri. Guest of Honor: Robert A. Heinlein; Fan Guest of Honor: George Barr; Toastmaster: Bob Tucker. Panels, talks, masquerade, films, presentation of the Hugos and the John W. Campbell Award for Best New Writer. Registration: $15 attending, $5 nonattending until January 1, 1976; $20 attending, $6 nonattending until May 1, 1976. Info: Post Office Box 221, Kansas City, Missouri 64141.

—ANTHONY R. LEWIS

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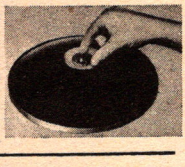

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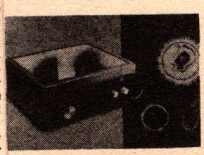

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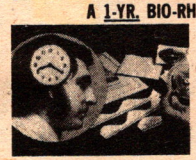

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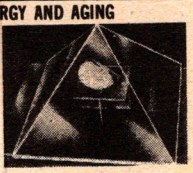

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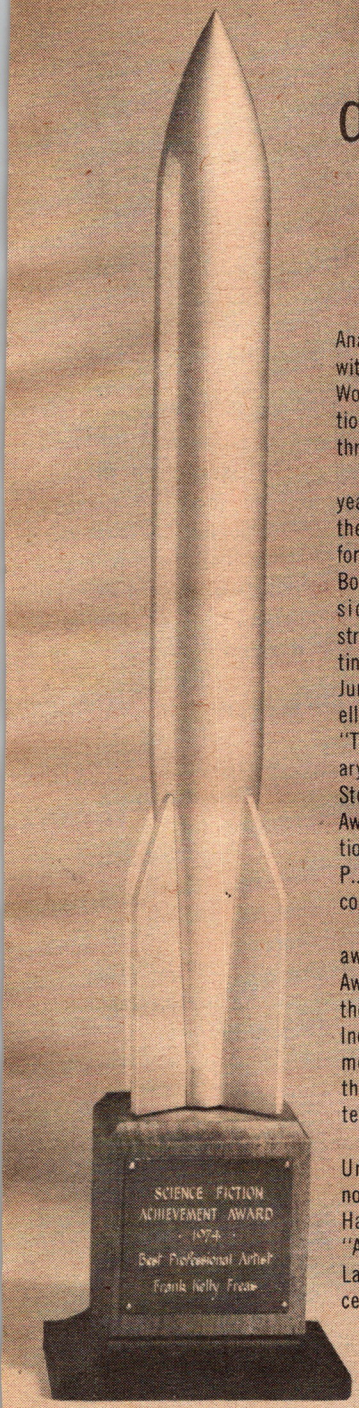
analog dominates hugo awards

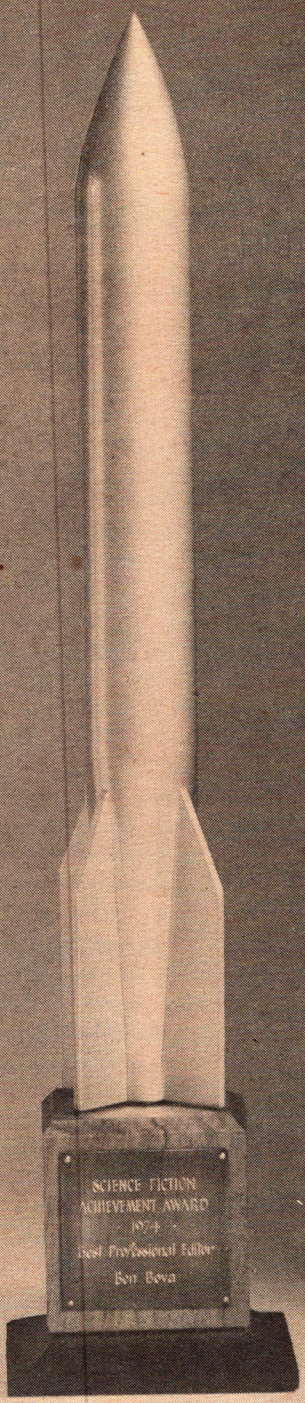
Analog contributors marched off with five awards at the 33rd World Science Fiction Convention in Melbourne, August 14 through 17, 1975.

For the fourth consecutive year, Frank Kelly Freas received the "Hugo" achievement award for Best Professional Artist. Ben Bova was voted Best Professional Editor for the third straight year. George R. R. Martin's "A Song for Lya" (Analog, June 1974) won the Best Novella award, and Larry Niven's "The Hole Man," (Analog, January 1974) was voted Best Short Story. The John W. Campbell Award for Best New Science Fiction Writer of the Year went to P.J. Plauger, a regular Analog contributor.

The "Hugo" achievement awards, as well as the Campbell Award (which is sponsored by the Condé Nast Publications, Inc.) are decided by vote of the members of the Convention. Thus the readers of science fiction determine who wins the awards.

Other Hugo winners included Ursula K. Le Guin, for her novel, "The Dispossessed;" and Harlan Ellison, for his novelette, "Adrift Just off the Island of Langerhans." Fritz Leiber received the Gandalf Award for his contributions to fantasy literature.





the broken promise

Step back in time thirty years. Read the exciting, optimistic reports about nuclear energy that filled the pages of Astounding Science Fiction and other magazines in the late 1940's. Nuclear power, so long one of those dreams that science fiction people cherished, became a reality. Nuclear weapons won World War Two! Nuclear power plants were going to transform the postwar world into a new era of peace and plenty for all. The average citizen was stunned by this stupendous new scientific breakthrough. Those wild-eyed science fiction fans had been right, all along! One of the "fall-out" results of the newly-born Nuclear Age was that science fiction became respectable—briefly.

It's interesting to note that, while the popular press of the time was eagerly quoting the Atomic Energy Commission's glowing reports of nuclear research progress and the inevitability of converting our entire electric power industry to nuclear power plants, John Campbell was one of the few voices of moderation. While he gladly pointed out the tremendous new *theoretical* capabilities of nuclear energy, he continuously cautioned that practical engineering developments always go slower and usually fall short of theoretical limits.

Today, thirty years later, that glowing promise of a clean, power-rich, bright new nuclear world lies in shambles. Energy starvation faces us. Nuclear power plants produce only about two percent of the nation's total energy. And even in the face of continued shortages of fossil fuels, every indication is that nuclear power plants will be producing no more than ten percent of the nation's electrical energy between now and the end of the century.

Why? What happened to that bright promise? The energy of the atomic nucleus is still there; it hasn't disappeared. The scientific knowledge and engineering skills are still with us; we haven't lost our brainpower. Why don't we have vast amounts of nuclear energy at our command?

Digression Question: What are three traits common to the government of the Roman Empire, *circa* Third Century AD, and the government of Nazi Germany?

Answer: (1) Large governmental bureaucracies that made it increasingly difficult to carry out administrative policies; (2) growing isolation of the governmental leaders from the real world; and (3) collapse and disintegration.

Conclusion: The death of societies is caused not by internal decay, moral turpitude, foreign invasion, or collective brain damage due to heavy metal ingestion. It is caused by strangulation, from the red tape generated by self-perpetuating bureaucracies.

The science fact article in this month's issue details the sad history of the nuclear rocket development program. Despite the desires of many government leaders—including the President who initiated the Apollo program—despite the years of toil from thousands of scientists and engineers, despite the obvious benefits that nuclear rockets would yield, there is no nuclear rocket engine today. A series of "safe" decisions led to death. By strangulation.

It is popular today, especially in the power industry, to blame overly-conservative environmentalists and overly-frightened "laymen" for the *very* slow growth of nuclear power plants. The moguls who run the power industry, and their public relations flaks, are quick to point to environmentalists' "alarmist propaganda" about the dangers of nuclear power plants. They shake their heads, more in sorrow than in anger, at the "scare tactics" used by citizens who don't want nuclear power plants in their communities. They gravely assure us that nuclear power plants are completely safe and reliable, and the only reason we don't have more of them is because a handful of crackpots and fear-mongers have riled up the hoi-poloi.

Nuclear power plants *are* safe. Far from foolproof, though. It's true that there's more stray radiation coming from the pile of coal outside a fossil-fueled power plant than coming out of a nuclear power station. The environmentalists have overstated the dangers from radiation leaks and potential catastrophic breakdown of the reactor's safety systems. And a psychologist might wonder if the widespread public aversion to nuclear power plants has any link to deepseated unconscious guilt feelings about Hiroshima.

But if we look at history instead of press releases, two facts become evident. First, although nuclear power plants are quite reasonably safe to operate, they are nowhere near as safe as they could be made. Second, the anti-nuclear activists were forced to raise their voices to a nearly hysterical pitch, mainly because the industry-government bureaucracy refused to admit to the public that there was any possi-

bility of harm coming from nuclear power plants.

For decades, the official reaction from the Atomic Energy Commission and the electric power industry has been, "Everything's fine; trust us." This, while they plow ahead with a game plan that had not been altered since the late 1940's. "Trust us." Despite the fact that the bureaucracy gave every outward appearance of ignoring the real world entirely.

The basic game plan for nuclear development went ahead as originally conceived. Uranium-fueled power reactors were developed and put into use in power generation plants. The gaseous diffusion technique for enriching the natural ratio of Uranium 235 to U238 was chosen as the best way to provide the enriched fuel that the power reactors required. Research was pushed on the breeder reactor, which could not only produce power but would "breed" high-grade fissionables as a byproduct, for use in other reactors.

The nuclear power generation plants have been plagued by all sorts of engineering problems, including unexpected cracks and hollows in the uranium fuel rods. The gaseous diffusion plants are enormously expensive and complex. The breeder reactor will produce enough plutonium to potentially poison the entire planet. And the radioactive waste products of the reactors will be a "garbage" problem for millennia.

But no matter. That was the plan, and that's the way the bureaucracy marched on. Doubters within the bureaucracy were hushed up or ignored. Environmentalists and questioning citizens were blandly patronized with a favorite phrase of tyrants: "We know more about it than you." When asked to share this superior knowledge, the bureaucrats declared it to be classified information.

So the doubters raised their voices to an hysterical pitch. And the power companies began to find that nuclear power plants didn't perform at the estimated efficiency, and were hideously expensive to build. And the Arabs forced our so-called "leaders" to scrutinize our entire energy situation.

Two specific examples of the bureaucracy's attitude of "Don't bother us, we know what we're doing":

An important facet in the economics of nuclear power plants is the cost of producing enriched uranium to fuel the reactors. In its natural state, uranium ores don't have a high-enough amount of the easily-fissionable U235 to be useful as a practical reactor fuel. The trick is to extract U235 from the natural ore, and then add it to the natural mix of U235/U238, thereby providing an enriched fuel. Gaseous diffusion is one way to do this. An-

continued on page 176

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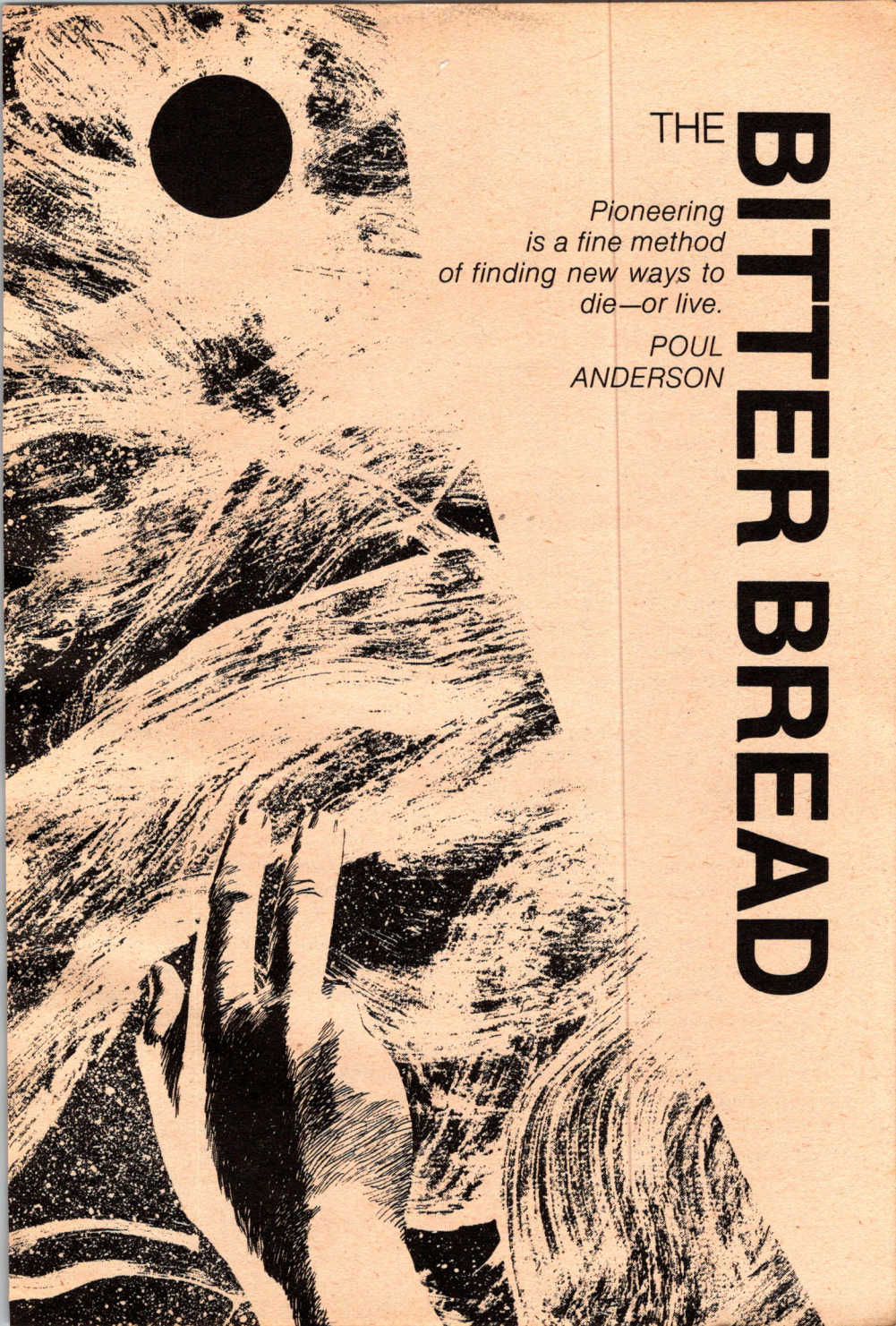

THE BITTER BREAD

Pioneering is a fine method of finding new ways to die—or live.

POUL ANDERSON

Seven years have gone since last we on Earth had news of *Uriel* in heaven, and I do not think we ever shall again. Whether they died or triumphed or their wild hunt still runs between the stars, yon crew has eternally left us. Should they after all return, it will surely be only briefly, with word and image for mankind and maybe, maybe a smile recorded for me.

That smile must then travel here, first in a shipboard tape, then in a code beamed through the sky, the censor, the global comweb to my house on Hoy. I shall never more see space. Three years ago the directors required me to retire. I am not unhappy. Steep red and yellow cliffs, sea green in sunlight or gray under clouds until it breaks in whiteness and thunder, gulls riding a cold loud wind, inland the heather and a few gnarly trees across hills where sheep still graze, a hamlet of rough and gentle Orkney folk an hour's walk away, my cat, my books, my rememberings—these things are good. They are well worth being often chilled, damp, a wee bit hungry. It may even be for the best that the weather seldom gives me a clear look at the stars.

Also, eccentric though I was to spend my savings on this place, rather than enter a Church lodge for senior spacemen, nobody will trouble to come here and examine my scribblings. Are they found after I am dead, they should not hurt my sons in their own careers. For one thing, I have always been openly kittle. The Protectorate must needs allow, yes, expect a measure of oddness among its top-rank technos. Of course, my papers would be deemed subversive and whiffed. So I put them each night in a box under a flagstone I have loosened, wondering if some archeologist someday may read them . . . and smile?

In the main, though, you archeologist, I write for myself, to bring back years and loves: today, Daphne.

When she sought me out, I had lately been appointed head of the *Uriel* relief mission. To organize this, I had taken an office in New Jerusalem, high up in Armstrong Center where my view swept across city roofs and towers, on over the Cimarron to the wheat-bronze Kansas plain beyond. That day was hard, hot, cloudless. The cross on the topmost spire of the Supreme Church blazed as if its gold had gone incandescent, and flitfighters on guard above the armored bulk of the Capitol gleamed like dragonflies. Though the room was air-conditioned, I could almost feel the weather beyond my window, a seethe or crackle amongst steady murmurs of traffic.

My intercom announced, "Mrs. Asklund, sir." I muttered a heartfelt "Damn!" and laid down the manifest I'd been working on. I'd

forgotten that, somehow, the wife of *Uriel*'s navigator had obtained a personal appointment. Hadn't I overmuch to do, in ghastly short time, without soothing distraught females? Eidophone conversations with two other crewmen's wives had been difficult—when at least they were accepting God's will in Christian fortitude, and wanted only to ask about sending messages or gifts to the men they would never remeet in this life. "Aweel, remind her I've but a few minutes to spill, and let her in," I ordered.

Then Daphne came through the door, and everything was suddenly a bright surprise.

She was tall. A gown of standard dark modesty did not hide a fine figure. The skirt swished around her ankles with the sea-wind vigor of her stride. Green-eyed, curve-nosed, full-mouthed, framed in coils of mahogany hair, her face wasn't pretty, it was beautiful. I saw there not sorrow but determination. When she stopped before my desk, folded her hands and bowed her head above them to me, the salutation had scant meekness. Yet her voice was low and mild, the English bearing a slight accent: "Captain Sinclair, I am Daphne Asklund. You are kind to receive me."

We both knew I did so because she had pulled wires. However, I could say no less than, "Please sit down, sister. I'd call this a pleasure were the occasion not sad. How can I be of help to you?"

She settled herself and spent a few seconds studying my grizzle-topped lankiness, almost like a friendly challenge, before she curved her lips upward a very little and answered, "You can hear me out, sir. What I'll propose isn't quite as fantastic as it will sound."

"The whole business is fantastic." I leaned back in my own chair and reached for my pipe. "Uh, I do sympathize. I'm affected too. Matthew King was my classmate at the Academy, and we were always close friends afterward."

"But you don't know Valdemar?"

"Your husband? Not really, I fear. The Astronautic Corps is small enough that we have occasionally been at the same conference or the same refresher training session; but it's big enough that we didn't get truly acquainted. He did . . . does impress me well, Mrs. Asklund."

"*Uriel*'s skipper is your friend. Its navigator is my husband. I hope you can imagine the difference," she said: no hint of self-pity, simply remarking on a fact.

I am not sure why, already then, I let go my reserve and told her, "Yes. My wife died only last year."

Her look softened. "I'm sorry. My apologies, Captain Sinclair. I've been too snarled in my personal troubles to— Well." She straightened. "Val is not departed, though. He . . . they all face years, decades of . . . endless trial." Exile, impris-

oned in a metal shell ahurtle among the stars—perhaps at last madness, murder, horror beyond guessing, till a lone man squatted among dead bones—she did not mention these things either.

I gathered myself to speak bluntly. "We'll do what we can for them. That's the duty I'm on, and you will forgive me if it leaves scant attention to spare for anybody Earthbound. I—I am told clergy are counseling the wives to—Well, they expect the Pastorate will soon permit, aye, encourage dissolution of any unions involved, and the ladies be free to remarry. Has not your minister spoken to you of this?"

She met my plainness with hers. "No. I am not a Christian. My maiden name was Greenbaum."

"What?"

"I'm not a good Jewess either, I admit. Haven't been to temple in years—that would have handicapped Val too much, professionally—but I could never bring myself to convert. Nor did he want me to." She left tacit the obvious, that his faith was probably mostly on his lips. Reading history, I have seen how tolerance has grown in the World Protectorate since its early days after the Armageddon War. But the time will be long yet before a professed non-Christian, not to mention an outright unbeliever, gets a spaceman's berth.

Daphne Asklund's background did help explain why her husband was aboard *Uriel*. The Corps doesn't exactly have a policy of giving its deviant members the most hazardous assignments. But they tend to volunteer for these, in the hope of advancement despite their social disadvantages or for deeper personality reasons. And then the tendency is to choose them from among qualified applicants, in compassion or a silent hope they may be more original and resourceful than average, or (I suppose) now and again a less honorable motive. Matt King, for instance, when young and foolish, had fathered a bastard. Or—I, commanding the relief mission, did not belong to the Absolute Christian Church but to a remnant of the old Kirk of Scotland; and kinfolk of mine, before I was born, were involved in the European Insurrection.

"Well," I said. "Well." My pipe and tobacco busied my hands. "Best we come to business. What do you want of me that lower echelons can't arrange for you? And why this visit, instead of a message or a phone call?"

"Only you can give me what I am after," she replied, "and you would not do it for a stranger. I don't expect you to say yes the first time."

You take for granted there will be more times, I thought. "Go on."

She drew breath. "Let me first describe myself. I hold full North American citizenship"—which had

opened the ears of men who could grant access to me, a client national—"but was born and raised in Caribbea. My father was stationed there as an engineer for the Oceanic Power Authority. I grew up swimming, diving, sailing, hiking; or we'd hop to the Andes and mountaineer. I still do such things—did, with Val. My father got me entry to the University of Mexico, where I took a degree in microbiotics. Afterward I was an assistant to Sancho Dominguez—yes, I helped him develop his improvements in balanced life-support systems for spacecraft. That was how I met Val. He was on the team that tested them, and came to the laboratory for conferences. After we married, I had to resign my job—you know how spacemen get moved around, also on Earth—but Dr. Dominguez keeps me on retainer as a consultant and has called me in on several problems. That's the main reason we put off having children, social stigma be damned."

An oath on a woman's tongue seemed not altogether wrong; when tears glimmered forth on her eyelashes. Did the golden cross throw too harsh a light, or had she all at once felt that now they would have no children ever? She blinked, lifted her head, and went on defiantly:

"A peculiar life, hasn't it been? Almost like a female's before Armageddon." She flushed, though her tone stayed crisp. "Except for their moral looseness, of course. But please understand, sir—check me out later on—in spite of my sex, I'm athletic, used to handling emergencies, scientifically skilled, a specialist in the very thing your expedition is chiefly concerned with—

"Captain Sinclair, I want to go along."

It happened that our propaganda department had completed the official film on this task, and screened it that afternoon for me and my staff prior to release. I invited Daphne to join us. "Frankly, the reaction of a wife may show us changes we ought to make," I said. Hesitating: "You may prefer to wait, and watch at home when it's 'cast. They've doubtless included shots of your husband."

"Could I wish not to see those?" she answered.

On our way to the auditorium, I explained the need for a dramatic presentation. Spiritual relations were no great problem. The Church could scarcely object to an errand of mercy. A few canons had expressed fear that men spending a lifetime shipbound, no chaplain among them, might fall into despair, curse God, yes, commit the sin against nature. But unless we let them starve, or slaughtered them, that risk must be taken. And in truth, the temptation was their opportunity: to smite Satan, bear witness, win sainthood.

As for temporal authorities, the Protector himself had approved our undertaking. He had more interest in science than Enoch IV before him or, for that matter, David III today. Out of disaster we could pluck a further-ranging exploration of the galaxy than anyone had awaited for generations. We might even find that long-sought dream, New Eden, the planet so like a virgin Earth that full-scale colonization is possible. Rumors reaching me said some of the Council had warned against that. Start men moving freely outward, and what heresies, what libertinisms and rebellions, might they soon spawn? However, at present the opposition didn't appear too strong.

The public was what we must convince, at any rate a sufficient minority. "Every special interest protests resources going to space research instead of it," I remarked. "You can't imagine the pressure. I didn't myself, in spite of being in the Corps, until I got this administrative post. The journalistic media don't report major disputes. That doesn't mean they don't exist."

"But if our rulers—" Hastily: "If most of the government endorses what we do, who cares about mobs?" she asked. I was to learn that she didn't lack charity for the humble of Earth, save when they threatened her man. And then her anger blasted mainly at their ignorance. ("Can't they *listen?* Why, just what's been learned out there about repairing radiation damage should have each soul of the millions that crater dust has blown across, down on his knees in thanks.")

I shrugged. "The Protectorate is only total in theory. In practice, it rests as much on being the compromise maker, the broker, between nations, races, classes, faiths, as it does on military force."

"Faiths?" she half scoffed. "When it keeps an established Church?"

"Och, wait, sister. You're educated, you know the Articles. The Absolute Christian Church is recognized as advisory to the government, no more. Membership in it can't be compelled. If nothing else, that would be politically impossible. Think of your own case."

"Ye-e-es. Still, you're aware what communicancy means in practice. And everything the Church calls a sin, the Protectorate has made universally illegal, under stiff penalties."

I stared. "Do you object? Besides murder and theft— Well, would you want lads and lasses free to fornicate? Your husband free to commit adultery? Or . . . forgive me . . . under his present circumstances, worse?"

Her nostrils flared. "He never would!"

"There, you see, the thought makes you indignant. Doesn't that prove you share the same moral code?"

"True," she sighed. "Mosaic principles. As internalized in me as in anybody, no doubt. I simply wonder if God wants us to shove them on others at gunpoint. Wasn't righteousness more meaningful before Armageddon, in those parts of the world where people were let choose for themselves? Where they could individually seek the truth, make their lives as they saw fit, why, it sounds trivial, but when women in particular could wear whatever they liked— Oh, never mind. Here we are, aren't we?"

I was relieved. We had been alone in the corridor, she hadn't spoken loudly, and hers weren't forbidden questions. But if a zealot had overheard, an embarrassing scene would have followed. Her chance of joining my expedition would have dropped to zero. I wasn't sure why I feared that, when I had insisted the idea was impossible.

Though the auditorium was uncrowded, Daphne sat next to me. As the room went dark and the showing started, she caught my hand and did not let go.

Our proppas had used minimum fake effects, where necessary to bridge gaps. They had ample real data to work with. Men aboard the associated vessels, *Abdiel*, *Raphael*, and *Zephon*, had taken excellent shots both before and after the catastrophe. In *Uriel* they kept cameras going too, and later transmitted what these recorded. Aimed almost at random, the lenses were cruelly honest. Our producers had not much more to do than choose sequences and add occasional explanatory narration.

I see, hear, all but feel and taste and smell the story around me now.

A thousand light-years hence, stars throng blackness, jewel-hued, icy sharp, marshalled in alien constellations. The galactic band and the clouds that cleave its silver are less changed to sight—except dead ahead, where a haze grows as the ships near, until it fills a quarter of heaven. White and flame-blue at its heart, the nebula roils outward to edges which are a lacework formed of molten rainbows.

Instruments take over, seeing and projecting what vision cannot. In the middle of that majestic chaos, two things which have been suns whirl crazily about each other. One, hardly bigger than Earth although more massive than Sol, has no light of its own, but flings back the fury of its huge companion's death. There are no words to tell of this. And yet the image is a ghost, a mathematical construct. Men who looked straight upon the reality would die before they knew they had been blinded.

Narrator: "Here crews have stood watch and watch for a score of years, ever since astronomers predicted that the blue giant would soon explode. Here was our chance to observe a supernova close at hand. Who could tell what we might learn? And what about its companion, a neutron star orbiting almost in contact? How was this possible? It must once have undergone the same throes, perhaps even more violent. But an outburst like that should drive the members of a pair apart, not together.

"We think probably there was a third member, also a giant, which blew up at about the same former time. Itself escaping, it took such a path that the second body was drawn close in toward the still steadily shining first. Friction with expelled gases must have helped shorten the orbit.

"Our investigators have searched for that third object. Its remnants cannot have traveled far, in cosmic terms. But they must be very feebly shining, or altogether dark, collapsed into a ball the size of a planet. We have not found them. God made the universe too big; let us put down our pride."

The tone cools: "Now that the last of the trio has erupted, the system is indeed breaking apart. Losing immense quantities of mass, the supernova must spiral away from the neutron star, and vice versa, to conserve angular momentum. But friction, again, hinders this retreat. It had scarcely begun when *Uriel* arrived, to relieve *Zophiel* on the regular three-month rotation plan.

"Certain persons question the sense of traveling a light-millennium, weeks at top quasispeed, for so short a season of duty. But we have no choice. The radiation around a recent supernova is too intense. Even under superdrive, a ship gets some of it, and a percentage of that comes through the heaviest shielding. Nor can the crew make accurate studies, entirely while moving faster than light. Much of their work must be done in normal state, at true velocity. Of course, then they extend magnetohydrodynamic fields well beyond the hull, control a plasma cloud, and enjoy quite effective protection. But no protection is perfect, unless it be divine. In view of probable cumulative dosage, the rule has been that three months is the maximum safe exposure time.

"In *Uriel*'s case, the period was greatly lessened."

The screen has been carrying diagrams and cartoons to clarify this physics for the layman. Next leaps forth a view from the observation bridge of a craft already on station, yes, I glimpse an officer whom I recognize, Ludwig Taube, aboard *Abdiel.* Cameras always record arrivals, to have information should misfortune occur. The scanning is Solward, whence the newcomer is expected. Those who wait will get no advance warning—what signal could outpace light?—but they have no reason to think King is off schedule, give or take a few hours. And, in a corner of the screen, see! The lean shape flashes into sight, into existence within the framework of relativity. It drifts off scene. Tracking, the camera catches and centers it. Stars appear to stream past; *Uriel* is moving swiftly across their field. Those in a cone ahead of the vessel show a flicker, their light rippled by its thrust drive as it decelerates. Taube's words: "What a hellbat of an intrinsic. I wonder why."

More drawings and narration explain: "—conservation of energy. A ship about to enter superdrive has a certain definite velocity—speed and direction—with respect to any other given object in the universe, including its destination. Crossing space with inertia nullified does not change that velocity, nor do gravitational wells affect it significantly . . . as a rule. In ordinary procedure, we try to match this so-called intrinsic to the intrinsic of the target, as closely as feasible, before starting the nonrelativistic part of our journey. Else we might have to spend too much fuel at the far end of the trip, where it can't readily be replaced. Not even the tanks of a fusion engine can carry enough for more than about five thousand kilometers per second of delta-V—that is, total velocity changes, both speedups and slowdowns, added together in the course of a mission . . ." Old hat. I noticed acutely how warm and tightly gripping was Daphne's hand.

Switch back to intership transmission. Matt King's blocky face appears, reporting to overcommander Cauldwell aboard *Zephon.* "Sorry about our excess V. I thought I had our vector well calculated."

"Don't fret," his superior smiles. "You're within acceptable limits—barely, but nevertheless within, praise God. Given the uncertainty and variability of parameters, you've done OK."

Jump to a date weeks later, Cauldwell before the board of inquiry on Earth. His features are worn and strained, a tic plagues his mouth, he speaks roughly: "Gentlemen, the guilt is mine. I should have weighed the possibility that the trouble was due to a fault developing within *Uriel,* worsening till a breakdown must occur."

"But nothing ominous had registered on their gauges en route, had it?" says the presiding officer. I know him. He is a man who, in the fear of the Lord, strives to be just. "We realize how intricate a thing a spaceship is. The least carelessness in maintenance can plant the seed of a terrible surprise."

"Father, forgive me," Cauldwell groans toward the infinite. "I should have thought seriously about that and ordered them straight home."

"Thus canceling their scientific projects: forever, because the stellar system would not have remained long in that particular state," declares the president. "No, Admiral, your decision was correct. Note well that King did not request an abort, nor any of his men. Our task is to track down whatever technician homeside was negligent, and find out what he did wrong." Pause. "The Pastorate will set his penance."

Narrator: "Seven men aboard *Uriel*—"

Singly, they go past us. Captain Matthew King, commanding. Lieutenant Commander Valdemar Asklund, navigator and first officer. Lieutenant Jesse Smith, chief engineer. Lieutenant Blaise Policard, second engineer and supervisor of life-support systems. That is all the crew which one of our marvelous wanderers needs, and each has been taught in addition how to assist the scientists. Those are not members of the Corps, though naturally in fine physical shape and sent through basic astronautical training. Nikolai Vissarionovich Kuzmin has planned especially to study nuclear reactions as they gutter out in the bared kernel of the ruptured star, Ioannes Venizelos gas and radiation dynamics in the nebula, Sugiyama Kito the gravity waves as configurations change. We see their lives, wives, parents, children—

Daphne, and I because of her, saw Valdemar Asklund as if he were alone.

He is a tall young man, lean, blond, narrow-faced, crinkly-eyed, readily smiling. His grays always seem the least bit rumpled, tunic open at the throat and bare of the ribbon to which he is entitled for his role in the daring rescue of *Michael.* His English carries the rise and fall of surf against the cliffs of that fjord where he was born. He was an indifferent student and barely got accepted into the Corps, but thereafter did brilliantly. Yet he is no spacegoing machine. He loves what remains of Earth's outdoors; he reads widely, with a special fondness for the comedies of Aristophanes, Shakespeare, Holberg, and Yarbro; he paints, plays chess and tennis, can cook a tasty meal or mix a powerful drink (that's a minor point against him, of course), is a genial host and sought-after guest; influenced by his wife, he is deep into the music

of Beethoven and has been learning the piano; he has likewise been pondering and quoting old American writings like the Declaration of Independence (good), though he omits the Churchly glosses upon them (bad); he keeps a seemingly unlimited supply of jokes for both stag gatherings and polite company; the more I see, the better I like him. And . . . those glimpses of him and Daphne which the filmmakers were able to dig out of this newsfile or that private album . . . appearances, frolics, the little possessions which turned their series of apartments into a single home—how happy they made each other!

Return our scene to space. Vessels extrude gang tubes, men cross between and cheerily fraternize, the chaplain aboard *Zephon* holds a special service for these seven who have gone weeks without hearing the Word from an ordained mouth. But time is fleeting. Captains and scientists confer. The four vessels will proceed in formation to the fringes of the nebula. Thence *Uriel* will plunge further, to conduct its first set of planned experiments.

The little fleet glides on superdrive to the initial goal. The three which will wait there, making different observations as they free-float in normal state, are sufficiently distant from the core—a quarter light-year—that their hulls and low-intensity MHD fields guard personnel from harm. Fading

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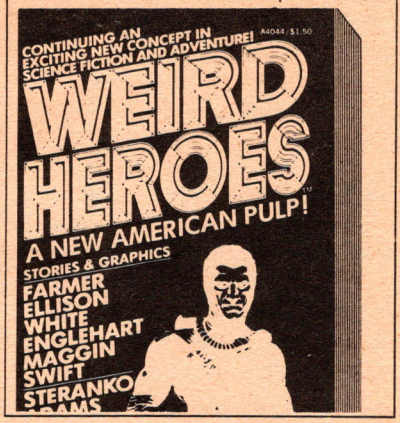

fast as it expands, today the burst sun gives them hardly more heat and X-rays than they would get in the orbit of Venus; the blast of leptons has already gone past this region, the baryons and ions have not yet reached it, the thin light-haze around is mainly due to excited interstellar gas.

Uriel leaves them. The recorded transmission includes sight of Asklund at his work. He reads off a string of figures, then abruptly grins, his head haloed in stars, waves, calls, "So long and cheerio."

Daphne's nails bit blood out of my hand. I did not stir.

Briefly back under superdrive, *Uriel* slips close, close to the inferno before reverting to normal

state, visibility, vulnerability. From protector nozzles gushes a cloud of plasma, which a heightened field wraps around the hull like a faintly shimmering cocoon. This will ward off not only the hurricane of charged particles, but the lethal photons . . . most of them. Should the dose aboard approach a safe limit, the ship will flee, faster than light.

These events must be shown in reconstruction. No outside lens, were any that close, could have spied a work of man against the nebular blaze. No message beam, were any receiver that close, could have pierced the wild electricity around. What we see is an impressionistic view, the craft large till it suddenly whirls off, dwindles to sight, vanishes amidst fire. Next, as if given the eyes of angels, we see the greater globe white-hot and still collapsing, the lesser burnt-out and compressed though now ashimmer, whipping in seconds through their orbit. And we see a dot which images *Uriel.* That dot plunges in.

Closeups: Needles abruptly aswoop across dials, numbers in screens changing too fast to follow, frantic chatter of printout; afterward men, whose resoluteness is a cage for horror.

Narrator: "Without warning, power failed. Engineers Smith and Policard could barely squeeze out the ergs to maintain radiation shielding. Nothing could be spared for either thrust or superdrive. The collapse of the MHD field for half an instant would mean death. There was nothing to do but work—find the cause of the trouble and make repairs—while *Uriel,* helpless, was hauled in like a comet by the gravity of two suns both heavier than Sol itself.

"The orbit had been established beforehand, to swing safely wide of the hot companion, slightly nearer the cold. Nobody had expected to continue in the path for long—certainly not till it almost grazed the sun-clinker. But this is what happened."

A scarlet thread grows behind the dot, marking its track through space. At first, time on the screen is compressed. *Uriel* had a high intrinsic in the direction of the double, whose mass accelerated it ever more furiously. Nevertheless the ship took days, terrible days to reach apastron.

Later, time is necessarily stretched. For close in, speed increases, increases, increases, dizzily beyond what the simple attraction of matter for matter can wreak. *Uriel* sweeps around the side of the neutron star opposite the late supernova, a moment in shadow which saves the men, since radiation is forcing itself past their screens in such amounts that every danger signal shrills. Acceleration climbs to better than half a million gees, five hundred kilometers per second per second. Thus the ship departs spaceward in the wink of a

quantum, too swiftly for its re-exposure to the starblast to kill. The acceleration tumbles down again; but by then, *Uriel* is coursing on the heels of light.

Narrator: "Bodies as massive as these two, spinning as fast, generate forces according to the laws of general relativity which act like a kind of negative gravity. That is what seized our unhappy men. They felt no drag, no pressure; they were in free fall throughout, and did not come within the effective tidal action zone. But their intrinsic mounted to more than fifty times what their thrust drive could possibly shed before fuel was exhausted. They were, they are trapped in the speed they have gained."

I meant to write down everything we saw, the pictures taken on board, the forlorn gallantry of men who toiled, suffered, prayed, endured, never really expecting survival nor, maybe, really wanting it. But I cannot.

I will merely write of scenes toward the end, that Daphne and I watched while she wept, my arm around her. The faulty powerplant has been repaired. The medication against radiation exposure is taking effect. The interior of the ship is cool again, scorch and sweat are gone from the air, pseudogravity generators once more provide stable weight, guardian fields scoop interstellar gas aside in an invisible bow wave so that rays no longer seethe through bodies; and a great silence has fallen.

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In awe, the seven stand on their observation bridge. Lengths are shrunken, masses swollen, time dilated. Doppler shift has muffled nearly all stars fore and aft, though a few glint wanly still. Aberration has drawn the rest of the multitude into a ring which, amidships, girdles enormous night, ranging in color from bluish through white to pale rose, the fabled starbow.

By no other light than that, Captain King leads his men in thanksgiving. "The heavens declare the glory of God: and the firmament sheweth his handy-work . . . For I will consider thy heavens, even the works of thy fingers: the moon and the stars, which thou hast ordained.

What is man, that thou art mindful of him: and the son of man, that thou visitest him?"

But Asklund stands erect, looking outward as if into the face of a foe.

Afterward they resume stations, start the superdrive; automatic optical compensators give them an illusion of being back in a familiar universe; they run toward rendezvous with their fellows.

Narrator: "In the inertialess condition, a difference of intrinsic does not manifest itself. Taking due precautions, crews from the spared vessels boarded *Uriel*, offered consolation, taped messages to bring home."

Some words are stammered, some stilted, some tearful. Asklund smiles almost wryly into the camera, though tenderness dwells in his voice: "—Daphne, darling, do you remember that old, old ballad I translated for you, about the dead knight who returns to his sweetheart? Do you remember what he tells her?

"For every time you're weeping
And sad your mood,
Then is my coffin filled inside
With clotted blood . . .

"But every time you're singing
And have no grief,
Then is my coffin filled inside
With rose and leaf . . .

"Please give me that gift. Live. Let me know and be glad that you're happy. Because I'll be alive myself, don't forget. This is no coffin. We can have good and useful lives, if people will help. If you will help, Daphne, by not mourning but living—" There is a little more.

Narrator: "*Uriel* stayed on cruise while the men recovered fully from their ordeal. Meanwhile the Astronautic Corps debated what is best for them. A plan is ready, a mission in progress."

Daphne swallowed hard before she whispered in my ear: "And Sinclair, I'm going too!"

Not till she returned from training did I learn, in part, how she got her way. The recommendation she magicked out of me was not enough, however hard I wrangled.

Director Jarvis: "Nonsense. The trouble and expense of teaching a one-shot rookie, when we've got career men? And a woman? Great Scott, just imagine the plumbing problems!"

Secretary Wardour: "Well, yes, it wouldn't hurt the Corps to perform a well-publicized act of compassion. But what kind of mercy is this, letting them meet for a couple of weeks in a crowded hull, her spacesuit always between them?"

Pastor Benson: "Propriety first. It would be extremely difficult, at best, for a sole woman to travel and work among men, in close quarters, without occasionally revealing what should not be revealed. Morality second. She could not help arousing lust. Oh, I realize

nothing untoward would happen. But minds would stray from godliness—from concentration on temporal duties also, perhaps, in that dangerous environment. Religion third but foremost. Might not the unexpected, stunning sight of her, an attractive female, briefly among men condemned to lifelong celibacy—not only her husband but the whole seven, young and virile—might that not weaken their resolve to accept the will of God? Might the memory not haunt them until at last they despair of his grace and fall into the Devil's claws?"

I was astounded when the OK came through. But I had been too busy to see much of Daphne or hear her schemes. And she was promptly whisked off to Luna base for two intensive months, while the load on me redoubled. You don't casually gather a crew, hop into a craft, and take off for the deeps. Look what happened to *Uriel*, where everybody supposed that everything had been checked out. The operation which I headed involved more unknowns yet.

Maybe you, archeologist, wonder why. In your ultrasophisticated astronautics (if God has not closed down technological civilization, lest we make an idol of material progress) what could be simpler than to lay alongside, both vessels in superdrive, and transfer cargo? Why, you may know how to kill such speed and let its victims rejoin the human race.

But we— Well, *Uriel* already had systems for recycling air and water. However, they were not completely adequate. Nobody had expected them to be in continuous use for half a century. They would degrade, poisonous organics would accumulate, unless we added refinements and ancillaries. And we couldn't simply plug in the new stuff. We had to do considerable rebuilding. Likewise, the ship had carried six months' worth of food. We would install closed-ecology units that would feed the men indefinitely, indeed yield a large surplus. But this too we couldn't merely dump aboard. It must be integrated with everything else. For a single example of our needful planning, remember that health and sanity required we leave the crew reasonable elbow room.

And while we labored, we must take elaborate precautions to assure no substantial number of atoms from *Uriel* got aboard our own ship. A few nanograms would destroy us, the moment we reverted to normal state and they took off at their light-like intrinsic velocity. There wouldn't be an explosion unless the mass was really gross, up in the milligrams or whatever. But from end to end of our hull would go a fatal wave of radiation.

Obviously, *Uriel* can never leave the inertialess state. It must always keep moving at a quasispeed which outruns light—a modern incarnation of that eerie ancient legend, the

Flying Dutchman. (What did the crew ever do, to merit their damnation?) Even if we invented a means to slow it, it would first have to enter normal state—would it not?—and our gift of supplies and machinery would annihilate it in a brief brilliance that might rival a nova.

Fortunately, fuel is no problem. The demands of life support are modest, those of keeping an inertialess body moving are less. Tanks topped off by us ought to serve for more years of exploration than those men have left in their bodies.

You may not believe me, in your hypothetical age of universal enlightenment, but fools have actually asked why *Uriel* didn't backtrack, once its superdrive was operational again, and let the double star undo what was wrought. Evidently, for them the narration was futile when explaining that a velocity is a direction as well as a speed. And, to be sure, Asklund calculated that at the rate yon companions are moving apart, already then they could no longer accelerate an infalling object in anything near the fashion they handled him.

Less crackpot was the suggestion that the ship find a safe, solitary and cold neutron star, go normal near its surface, and let gravity act as a brake, repeating this process until the intrinsic was down to a reasonable figure. But doubtless you need not do the arithmetic to estimate how many passes this would require. The limited food stocks would be exhausted years before an end was in sight.

Another double of precisely the right characteristics, or any of several more exotic and hypothetical things, could reverse the effect, yes. While we have not publicized the fact, *Uriel* spent what months were possible on minimum rations, before reserves got hopelessly low, seeking just such a deliverance. The hunt was foredoomed, of course. Recall the sheer size of space, and guess at the probabilities. Then think what spirit was in those men, that they tried.

Further search is pointless. The equipment of survival, which we have given our comrades, has a differential intrinsic of almost three hundred thousand kilometers per second: to the best of our present-day knowledge and imagination, irrevocable.

Why is my dictascribe trudging through elementary physics? Don't I want to remember how Daphne came back to me?

She protested the two-week furlough granted our crew before departure. They were edging starvation in that ship. I told her the custom was vital. We dared not go to space tired, tense, unrefreshed by our loves. We would meet our deadline, which King and Cauldwell had determined between them a thousand light-years from home. Let her not fear.

"Yes, I've been told," she said. "I'm sorry I grew impatient."

"You have a downright duty to enjoy yourself." I wagged a finger at her. "Where will you go, if I may ask?"

"Well," she said, "my parents have passed away, I haven't anybody close, I'd like to, oh, bid Earth good-bye. Luna was magnificent but stark. Doesn't the Corps maintain a wilderness resort?"

"Aye," I answered, and changed my mind about visiting my sons.

Autumn descends early upon the Grand Tetons. Except for the lodge staff, we had this part of them to ourselves. During the days we tramped their trails, canoed on their lakes, dared their glaciers, found nooks of sunlit warmth and sat down to wonder at their birds, beasts, trees, and distances. Evenings we attacked dinner, surprised at how often we japed and laughed; afterward we took our ease before a stone fireplace, in dimness that burning pine logs made flickery fragrant, and talked more seriously, traded memories, thoughts, and—shyly at first—dreams.

I will sketch a single hour, soon after we arrived. We left in the morning for a hike to the peak above. Our path took us through a wood where leaves glowed in crystalline sunlight, scarlet maple, golden birch, fallow aspen. Between their slim trunks we saw how the mountain slanted toward a dale where a brook went rushing, and how on the far side the range lifted anew in white and violet purity. The sky was like sapphire. The air was chill in our nostrils, smoky when we breathed out, sweetened by faint odors of soil and damp and life. Sometimes a raven went "Gruk!" or a squirrel streaked up a bole and chattered at us; twice a flock of geese passed overhead, their calls drifting down; else our footfalls resounded through holy quietness.

We stopped a while to rest. The ground was soft beneath us. Daphne sat looking outward, arms clasped around knees, cheeks flushed from our climb. The warmth of her went over me in a wave. Her hair, tumbling from a headband and across her shoulders, shimmered as bronze does, or heavy silk.

She said at last, low, maybe to herself, "Val spoke of this country a lot. We were going to pay a visit together. But something always made us postpone. We didn't really understand that we weren't immortal. So now it seems we never will come."

"You will," I promised.

"I . . . won't be able to. I'm temporarily associated, not actually in the Corps."

"I can bring guests."

She turned her head and gave me a grave smile. "Thank you, Alec. You're kinder to me than is right. But no. I've seen what it

costs, and won't have that sort of money."

"Eh?" I was startled, having read the dossier on her which Personnel compiled. "I thought your parents left you quite well off."

"They did. Everything's gone for a bribe, though."

"What?"

She chuckled. "Poor shockable Alec! Nobody told you? Oh, not strictly a bribe. I informed the Pastorate that if it would approve my going in your gang, and pressure an acceptance through secular channels, I'd donate my inheritance to the Church. I dropped a strong hint that otherwise I'd endow a synagogue. They huffed and puffed, but in the end—" She shrugged. "I'll spare you the list of my other blackmails, browbeatings, bluffs, and deceits."

"Lass, lass," I whispered, "how can it mean that much to you, squinting at him through a helmet visor?"

"It does."

I gathered courage to say, "He himself begged you to put him behind you."

She looked back toward the snowpeaks. "I don't think I can. 'In plenty and in want; in joy and in sorrow; in sickness and in health; as long as we both shall live.' " Her hands, groping about, closed on a fallen dry branch. "I . . . suppose . . . I'm more of a monogamist . . . in my way . . . than he is." The noise was startlingly loud when the branch snapped. "But he does love me!"

A deer bounded into sight. Our gaze followed, enchanted. "He loves Earth also," she ended, "and he's been forever shut away. Shouldn't I bring him what touch—what remembrance I can?"

To hurt him the worse? Have you thought how selfish you maybe are? I barely halted my tongue, and hunched appalled. What good would lie in lashing out at her craziness? The fault was mine. I should have stood on my veto at the beginning. Now we were locked in. She was precision-fitted for a crucial role. Quite rightly, the directors would not allow me to substitute her backup for any reason less than a medical emergency. Nor would she ever forgive me.

Whereas—Very well, keep silence, let her get that adieu out of her system. Afterward—

"You find this a bonny land, do you not?" I asked rhetorically.

She nodded. "I'll never forget," she murmured.

"You need not hanker," I told her. "When we return to Earth—" My heart slammed. "We can come here. Whenever we're both free. No matter money. I draw a good wage, and nobody depends on me anymore."

"Oh, Alec!" For an instant I glimpsed tears. For another instant her arms were around me, her face buried in my shoulder. Then she leaped up. "C'mon, lazylegs!" she

cried, and we were on our way again.

We made rendezvous beyond Mars, where *Uriel* had lately been flying a prearranged exact circle. Knowing position and quasispeed of the exiles, my instruments, automatons, and I brought *Gabriel* carefully closing in. When the two counterinertial fields, extending a few kilometers beyond either hull, began to mesh, I saw ghostlike waverings across the Milky Way. As we neared, our objective solidified. Having reached the same phase, an optic screen showed it not far off, as real among the stars as we were . . . or as unreal, in this mass-annulled condition we shared.

"Synchronism achieved," I mumbled into the intercom, and sank back in my pilot chair. The process had been slow, trying, dangerous because of the short range within which mutual detection was possible; inside our fields, we still had inertia with respect to each other if not to the outside cosmos, and a collision could wreck us both. I smelled the sweat rank on me, heard breath and pulse rattle, felt the separate stiffnesses and aches in a body no longer young.

"How are they?" rang Daphne's voice. "May we see?"

I decided I wasn't ready for the boneyard yet, and switched the telereceivers aft into the visual compensator circuit. A buzz of excited talk reached me vaguely, from my men. They were five altogether besides her, excellent fellows, who had treated her with awkward chivalry while we rehearsed and at last ran outward from Earth orbit. I wish them well. But none of them especially matters.

"Maintain stations," I ordered. "I'll try for contact." Right off, I saw my mistake. "I'll make contact," I amended. They must not be dead or insane over there! My fingers stumbled across the com panel. "*Gabriel* to *Uriel*, come in."

"*Uriel* to *Gabriel.*" The screen flashed color. Matt King stared forth. His eyes and cheeks were sunken back among the bones of his face, and he spoke in a hoarse whisper; but he was clean, closely groomed, crisply uniformed. My worst fears drained out of me. "Welcome, welcome." He managed a shaky smile. "You're skippering the mission, are you, Alexander Sinclair, you old rascal? What a pleasant surprise."

"How is everybody?" I barked.

"Basically healthy, praise God. Weak but functional, and we got out of the habit of hunger six months ago. Morale is, um, not bad. We do hope you've brought steaks and champagne! When do you expect you can board?"

"We need rest, and I want a complete final cheekout of every system . . . Let's say in twenty-four hours. I'm sorry it cannot be sooner. Uh, I wonder if Valdemar

Asklund could come to your pickup?"

"Why, well, yes, if you wish."

"Will you report to the command bridge?" I said into the intercom. No reason to state who.

She arrived just as Asklund's hollowed-out countenance appeared. Through a minute or more, they were dumb. I might not leave my post until relieved by Roberts, my first officer; but I glowered at the optic screens. In one of them, its radiance stopped down for the sake of my vision, the sun looked shrunken and cold; in another, Earth shone deep blue, loveliest of the stars and somehow more distant-seeming than any else; in the rest gleamed inhuman hordes and the immensities between.

Finally I heard Asklund sigh, "Daphne, why?"

"To be with you," she wept.

"When we can't even touch? I . . . we're going away as soon as—Oh, my dearest, I worked for weeks on a message to record for you, and now—no words—" I heard him weep too.

Presently she said, "I'll be busy, you realize. I'm responsible for the core parts of your food-cycling equipment. But you can assist me, and—and Captain Sinclair did promise we'd have chances, a compartment where we're by ourselves, or a private line—"

To talk.

We used no gang tube. A handful of air molecules, diffusing from *Uriel* to *Gabriel*, would bring the same doom on us. Instead, we kept the ships as far apart as synchronicity allowed, and jetted across in spacesuits which we wore during an entire shift. This handicapped us infernally. Sheer bulk got in its own way. Gloved fingers, being clumsy, must often operate specially designed manipulators. Speech was via sonic amplifiers, likewise a nuisance. But there was no help for it; and, to be sure, as we instructed them in the requirements, our outcast comrades became quite skillful teammates. Returning to our vessel to eat and sleep, we paused outside the entry lock and practiced elaborate rotations and contortions while an infrared beam boiled off whatever atoms might cling to our suits, and well-nigh baked us. Those were the more obvious physical discomforts.

And they were not what made us long to finish and be gone. No, it was what *Uriel*'s men said, generally with Spartan mildness, and their eyes upon us, and the way they handled the letters, pictures, tapes, mementos we brought them.

I remember a talk out of many which King and I had. We were off duty, seated in our cabins, using an exclusive frequency. This is standard on spacecraft, whose captains may have to reach a grim decision. We let Daphne and her husband into these cubicles at a regular hour out of the twenty-four.

King poured whiskey from a bottle, my smuggled gift, raised the tumbler, and toasted, "Here's to our noble selves." I responded in kind. He didn't show it, really—indeed, having begun to flesh out since we brought abundant food, he looked better than erstwhile—but he had let himself become a trifle drunk.

"Or skoal, my navigator would say," he added.

I let the drink glow down my throat. The leastmost cheer felt large. What had I around me? Three meters by two of room, gray-painted metal, bunk, locker, chair, desk, reference works, Bible, a file of favorite books and a microreader for them, a small musical library and player, a harmonica that I occasionally tootled on, pipes and tobacco, photographs of Meg who was dead and our sons who were grown—that, and starriness outside.

But I could go walk on planets of yon suns, including a planet named Earth.

"Your pronunciation is wrong, Matt," I tried to laugh.

"How do you know?" he bridled. A ventilator muttered around his words.

"Well, ah, Daphne Asklund told me I had it wrong, and taught me a closer approximation." I took a second swallow, much sooner than I had intended.

He peered at me. "Why did she make you bring her?"

"What? Why did I? I've explained. She told you herself. She saw how to join her husband this brief while—unless when you return to the Solar System—and since she could in fact carry her share of the load, I had no heart to refuse her."

The image of his head shook from side to side in the cramped screen. "Don't evade my question, Alec. It wasn't about your motive—that's pathetically obvious—but hers. Nobody who wasn't . . . terrifyingly . . . strong and clear-headed could have swung what she did. I know how these things work as well as you do; I can make the same estimate of the barriers she had to break down, the powerful men she had to outface and outsmart. Such a person doesn't do such a thing for an orgy of sentimentalism that can only agonize her man. Then *why?*"

"Who knows what drives a soul?" I counterattacked. "Do you understand yours? I don't mine. How is Asklund taking it?"

"How does he strike you? I've been meaning to get your outside opinion, Alec, to check my impression. We'll spend the rest of our mutual life together; I'd better have an accurate judgment of him."

I needn't stop to ponder, having done that in uncounted wakeful nightwatch hours. "He was knocked off his orbit at first, I'd say. But he appears to have recovered fast. I don't see him much, you ken, and almost always in public, at work. He's calm, competent—rather withdrawn, I think. They both are."

"He wears a stout mask." The lines deepened around King's mouth. "I gauge him as being under the tightest, breaking-point control."

"Is that uncanny?"

"No, I suppose not. My other men—she's causing them trouble too, not as intense but nevertheless trouble."

"Psychological disturbance was foreseen and allowed for. Still, what is she to them? A bulgy suit like everybody's from *Gabriel.* A face in the visor, a voice out of a speaker, aye, those are female. But men throughout history, in military units or monasteries, have seen more of women, and not been tantalized beyond endurance."

"Soldiers expected to get home; monks expected to keep vows they'd made. We're neither. Already Blai—an astronaut has admitted to me being in love with her. I myself—" King tossed off a mouthful and quirked a smile. "Oh, we'll get over our emotions, our itch, that is. But frankly, I'm thankful this will soon end. Please don't let her join in the next rendezvous."

Wordlessness hummed between us.

"Have you decided where you will go first?" I blurted. We'd

brought a bundle of recommendations from different scientists, but the *Uriel* crew had taken no opportunity thus far to study these. King had mentioned how, in the months of their hunt for a savior star, they discussed every imaginable possibility and contingency. What else was there for them?

And what else had they to do in the years that remained, but range the galaxy, and, from time to time, bring us tales of their discoveries? A radio capsule, shot free of the counterinertial field, could summon our people to a meeting. Though we dared not accept any physical record, we could make copies.

But we could merely request and recommend, never command. They were untouchable.

"A shakedown cruise," he answered. "To the Orion Nebula. You know what a lot of unsolved puzzles it holds, and . . . we'd like to see new suns being formed. Then, when we're reasonably sure of our ship and ourselves—the long jump. Clear to galactic center."

I was not altogether surprised. Nevertheless—"Already?" For that would be a voyage of years; and opinion continues divided as to whether, beyond the vast dust clouds which hide it from our probings, the heart of the Milky Way is a hell of radiation or—

"The Elders," he capped my thought.

Surely we are not the solitary species who fare between the stars. God is too generous for that. Far out in this fringe of a spiral arm, barely starting to fumble around off our home shores, we must be like cavemen on a raft, compared to races ahead of us which, maybe, are not burdened by original sin, not plagued by the Devil or a myriad lunacies. Half our astronomers think the middle regions are clear, the suns close together but old and benign, the likeliest hearths of beings whose recorded history runs for multiple millions of years—

—and who might even know how to lift the curse off *Uriel.*

"What have we to lose?" King said.

To that same room came Daphne, at the close of our mission.

When I heard her knock, I soared from the chair where I had been grinding at return-trip calculations, hit my knee on the desk, and in the pain swore at myself for a lubberly old gowk. Aloud, I called, "Enter." She came through in her pride and gentleness, and I forgot about hurting.

"The captain summoned me," she uttered formally. Her eyes were the green of Earth's living seas.

"Aye. Please shut the door. Sit down." I gestured her to the chair. As she brushed past, touching me, I scented her warmth afresh, after these many days in spacesuits or a crowded mess or a bunk alone. When she was seated, her gaze

must travel too far to meet mine. So I perched on a corner of my desk, swung the foot that was free of the deck, and speculated at the back of my mind whether this made me seem younger.

Did she, regardless, bear dread behind her face? I studied closely. She blinked, drew a long breath, then eased back and smiled. "Everything I've worked on checks out swab-O," she said. "And my fellows tell me they're satisfied."

I nodded, while fighting my throat.

"What can I do further?" she asked, neither wondering nor defying but quietly helping me along.

"You—" I tried again. "You are in a, an unco situation, lass. I couldna but see— Well, tomorrow mornwatch we go to *Uriel* for . . . we canna call't a celebration—a speech or twa—and—"

She said (how kindly!), "You wonder if Val and I have any special last request, don't you, Alec?"

"I've seen your glove seek him."

She laid her hand across mine where it clenched the desk edge. Is not a woman's hand twice beautiful on the knobbly hairy paw of a man? "If we could go off by ourselves, to Matt King's cabin or wherever, a while, we'd be grateful."

"You know you can that." I snapped after air. "Why I called you here . . . I'm not quite sure. I thought, 'twill be a hard farewell. And he, Val, he does trust you'll build a life of your own afterward. I want you to, to know you have a friend here who cares for you very much, Daphne. How can I be of service?"

"Oh, Alec, Alec." Suddenly she kissed me, and fled crying.

At last I slept.

We would have been mad to leave *Gabriel* long unattended, on automatics. Nor could anybody stand much ceremony. But rightness required that, together, we see directly through our visors our comrades for whom we had toiled and clasp them good-bye in our armored arms, and wish them godspeed till death or a miracle delivered them.

Crossing over, I flew as near as might be to Daphne. She was half a shadow, half a shimmer, amidst the stars and silence around. I heard naught save a radio hiss in my earphones, a thrum of thrust, my heart knocking. At breakfast, some of us had been boisterous and some bleak; she had been unreadable; now none talked. Did we feel guilt, that soon we would know blueness, clouds, rain, leaves in the wind? Myself, did I do wrong to hope?

The sternest realism I could muster warned she would remarry, if she did, for convenience and companionship. Well, I dared not want more.

My boots thudded on *Uriel*'s hull.

We cycled through the lock. At the inner valve waited Matthew King, Jesse Smith, Blaise Policard, Nikolai Kuzmin, Ioannes Venizelos, Sugiyama Kito, Valdemar Asklund. No longer grimy in coveralls, no longer starved, and no longer looking forward to human advent, they stood in dress uniforms as if on parade; and I saw that these brave, decent men were unsure how they might comfort us.

"Welcome," King said. Walking down the corridor, he took me around the waist. After half a second I was ashamed that I was shocked. He did have womanless years before him, but I was his old friend, and muffled away from the very air he breathed, and due to depart in an hour. Next I noticed that, while Daphne and Asklund were side by side, they had not embraced as they did when first she boarded. Their faces were as shut as her helmet.

What had she told him, in the privacies we gave them?

Though we fourteen had fractional room to move around in the mess, we quickly took places at its table. By prearrangement, *Uriel*'s crew had set out glasses and the last bottle of champagne. They would drink for both and we, homeward bound after this was done, would pray for both.

King stood up, klinged thumbnail on goblet, and said: "Mrs. Asklund and gentlemen, we cannot reckon or repay what we owe you. I speak less of your help which will let us live on—that was rendered in the tradition of the Corps—than of your spirit, your generosity—"

I, rising to respond, said: "Brothers, forgive a, a wee bit of dramatics. From your wives, children, parents, your kin and closest well-wishers on Earth, we brought what they gave us to bring you. But we held back one small thing for each till now, whatever they felt would be extra special—"

We tried together to stay calm, and even I hardly saw the Asklunds excuse themselves and leave.

"—we will never forget," I was saying; "mankind will never forget," when they made re-entry, bare hand in hand. She wore her undergarb, and carried high her head and the unbound ruddy hair.

I am a starship captain, therefore disciplined into command of myself. I roared the chaos around the table back to order. Matt King came to my help. Daphne and Valdemar waited calmly.

Jezebel, harlot of outlaws, wandering Jewess—what pain did the curses give her, give them, when *Uriel* returned for the first and last time to report wonders? What freedom have they found to keep them away ever since, if death does not? And what interior victory, readiness of both to give ungrudging love, must he and she have won before at last, in sight of us all, she kissed her man full upon the mouth? ■

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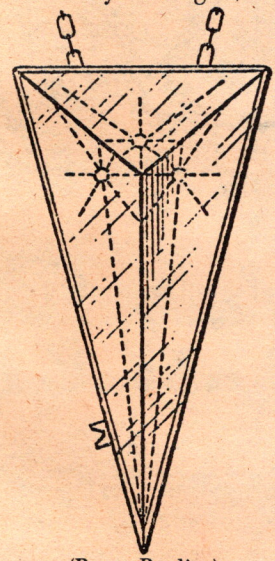

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The reason airplanes don't use steam engines is the same reason we don't have nuclear-rocket-powered spacecraft.

DONALD KINGSBURY

ATOMIC ROCKETS

In the summer of '44 just after the Allied Forces had landed in France, my fifteen-year-old mind was in the middle of a mad scheme to earn money with which to take girls to the movies. I was writing the story of the first atomic Moon rocket, certain that I could sell it to Astounding. For some strange reason nobody was writing stories about U-235 and I was sure I was going to corner the market.

I cajoled my mother into buying me a copy of Willy Ley's *Rockets* as a reference book for my story. It was three months before the German V2 assault on London, and fourteen months before Hiroshima.

In that first edition of Willy Ley's famous book there was only a single reference to atomic energy. "At present nobody can manufacture U-235 in lots visible without a microscope. And while U-235 releases enormous amounts of energy, that energy appears simply as heat and it is hard to see how it could be applied to rockets."

I wrote Willy Ley a scathing letter condemning him (of all people) for his lack of imagination and foresight. He good-naturedly wrote me back explaining that because of the war he wasn't allowed to discuss U-235. Later that year John Campbell sent me my first rejection slip. My wooden heroes didn't do anything. They just took a single stage uranium-powered rocket, went to the Moon in the summer of '64, walked around in their spacesuits, took samples of Moon rocks, and came back. Too dull for a story.

What happened to *that* future?

In the late Fifties and early Sixties the race between chemical and atomic rocket motors went decisively to the voracious *and marginal* LOX-kerosene F1s and the LOX-hydrogen J2s of the Saturn launcher while the nuclear rocket that came to be called NERVA evolved into an underpowered motor that left no alternative but project cancellation. The atomic rocket motor appeared to be feasible and was the clear victor in potential performance. But the chemical fuel team was led by extraordinary men with imagination.

Why, in theory, does an atomic rocket so persuasively outperform a chemical rocket?

There are two major factors we must consider when we engineer a rocket motor—its exhaust velocity and its thrust/weight ratio. The exhaust velocity relates to efficiency and translates inversely into things like how many dollars it takes to get a kilogram into orbit. The

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(On previous page) The way it was . . . not. In 1950 everybody "knew" that nuclear rockets were the best way to reach the Moon. So when Robert A. Heinlein wrote the script for the George Pal production of "Destination Moon," he used a nuclear-engined one-stage rocket for the story: a science fiction prediction that should have, and could have, come true. But didn't.

thrust/weight ratio becomes important if we have to operate out of a steep gravity well such as Earth's. Our motor must have enough lift to get the whole ship off the ground.

EXHAUST VELOCITY

The single most cost sensitive rocket variable is the engine's exhaust velocity. This is because the velocity of the rocket gas enters our performance equations in the exponential formula for mass ratio, the ratio of the initial ship mass to the final ship mass.

In free space the formula for mass ratio is: $r = e^{v/c}$ where $e = 2.71828\ldots$, v is the desired change in mission velocity, and c is the exhaust velocity. For back-of-the-envelope calculations it is quite good enough to use: $r = 3^{v/c}$. The mass ratio computation for a blast-off from the Earth's surface gives us a greater number than for free space because closer to the Earth we lose velocity while we are fighting gravity and that costs reaction mass.

To see how cost is related to exhaust velocity consider the mission of delivering a solar power station into synchronous orbit. That mission requires a change of velocity of approximately 11,000 meters/sec. With an exhaust velocity of only 2,500 m/sec (Saturn's first stage at sea level) we would need a rocket mass ratio of *at least* 81:1—assuming no gravity losses. With an exhaust velocity of 4,500 m/sec (modern LOX-hydrogen motors) we need a mass ratio of *at least* 12:1. An atomic rocket with an exhaust velocity of 8,000 m/sec would require a mass ratio of 4:1. Cost comes down dramatically with increases in exhaust velocity.

Chemical rockets have *already* achieved exhaust velocities close to their theoretical maximum by going to high pressures (the Space Shuttle main engine—the SSME—burns at a chamber pressure of 200 atmospheres) which allows high expansion ratios. The improvement in their performance over the next thousand years will be marginal. Their advantage over nuclear rockets has been essentially in the ease

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Our mass ratio in a constant gravitic field, assuming constant acceleration (thrust proportional to remaining weight), and constant angle of flight is: $r = e^{(v + gt \sin A)/c \cos B}$; *v is mission velocity, g is the gravitic acceleration, t is the time until burn-out, A is the angle of flight from the horizontal, B is the angle between the direction of flight and the direction of thrust. To achieve optimal mass ratios we must keep the factor* $gt \sin A$ *as small as possible; and the angle B as close to zero as possible. Thus efficiency means rapid burn times (small t), and turning the rocket toward the horizontal (*$\sin 0 = 0$*) as soon as practicable. Rocket accelerations much larger than g or near-vertical flight assure that the angle B will be close to zero (*$\cos 0 = 1$*). In the practical case where thrust is* not *proportional to remaining mass, but is constant, we begin the flight vertically to keep B small, and then as the acceleration becomes very much larger than g we tip into a more horizontal flight pattern to keep A small.*

with which we have been able to engineer them to deliver high thrust/weight ratios.

Atomic rockets, on the other hand, have little trouble delivering high exhaust velocities when using hydrogen as the propellant. Exhaust velocity is roughly proportional to the square root of the absolute temperature after it has been divided by the molecular weight of the exhaust gas. If the exhaust gas is water our molecular weight is 18, if it is hydrogen the molecular weight is 2. Therefore, given the same temperature, an average hydrogen molecule will have a velocity of approximately 3 (the square root of 18/2) times that of a water molecule.

Thus an atomic rocket motor ejecting hydrogen gas at room temperature can compete with the F1 motor of the Saturn's first stage which exhausts the heavier molecules of water and carbon dioxide. At temperatures approaching the melting point of aluminum (933K) we become competitive with LOX-hydrogen motors. Hydrogen heated to the temperatures in a potter's stoneware kiln (1,530K) and expanded at a ratio of 200:1 will give an exhaust velocity of 6,000 m/sec, better than any chemical propellant could ever do. The NERVA motor achieved hydrogen gas temperatures (2,300K) 500 degrees above the melting point of iron, near the boiling point of aluminum, and yielded exhaust velocities above 7,500 m/sec. Near the melting point of the refractory metal molybdenum (2,890K) our exhaust velocity would be 8,700 m/sec at an expansion ratio of 200:1. And in the range of the melting points of tungsten (3,680K), niobium carbide (3,770K), and tantalum carbide (4,150K) we would have exhaust velocities above 10,000 m/sec.

THRUST/WEIGHT RATIOS

The thrust/weight ratio of a rocket motor is not an absolute thing. The Saturn's F1 delivers a thrust of 685,000 kgs and weighs 8,400 kgs for a thrust/weight ratio of 81:1, but on the Moon it would only weigh 1,400 kgs so its thrust/weight ratio would be 490:1. In space, where it weighs nothing, this ratio is infinite. Thrust/weight is simply a measure of how much you can load a motor down with such things as tanks, fuel, ship's structure and payload and still get "lift off."

The formula for exhaust velocity in meters/sec is:
$v = 128.9\sqrt{T/pM}\ \sqrt{1 - E^p}$, *where T is temperature Kelvin,* $p = (k-1)/k$, *where k is the ratio of the specific heat at constant pressure to the specific heat at constant volume, M is the molecular weight, and E is the expansion ratio. For instance, E might be .005 if we expanded from a chamber pressure of 100 atmospheres into an ambient pressure of half an atmosphere. Typical values for k for hydrogen at 100 atmospheres are 1.39 at 1,000K, 1.33 at 2,000K, 1.26 at 3,000K.*

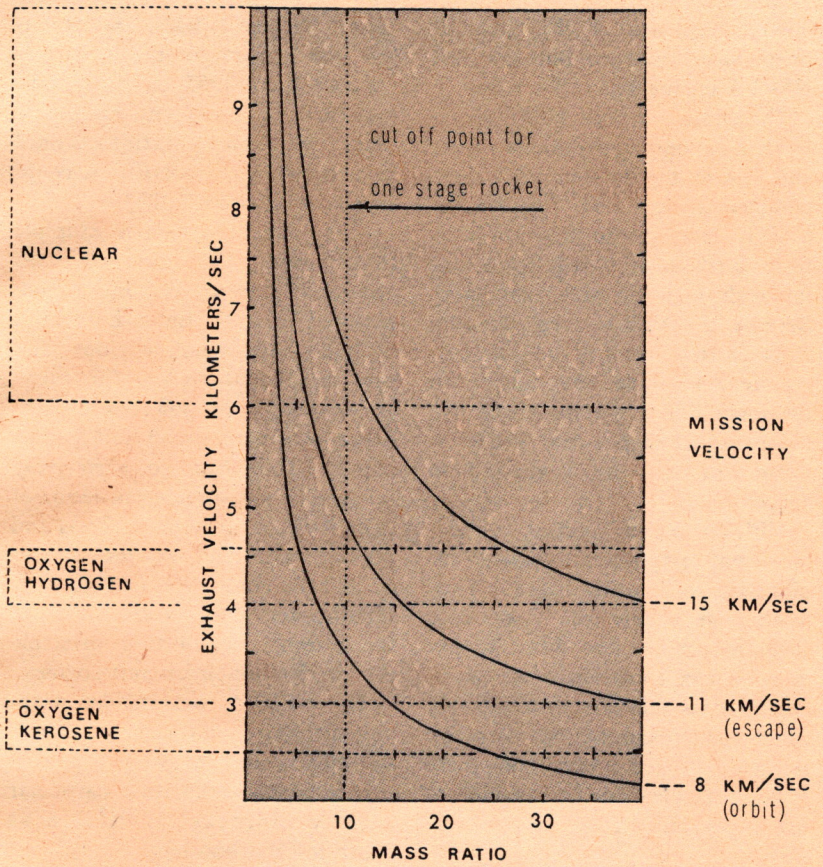

Figure 1: Exhaust Velocities, Mass Ratios and Mission Velocities for Atomic Rockets vs. Chemical Rockets.

By comparison with the F1, the XE-prime which was the last tested NERVA design, weighed 18,000 kgs and delivered 25,000 kgs thrust for a thrust/weight ratio of 1.4:1. Each kilogram of engine could carry 400 grams. The NERVA project could have done better than that but not much better. When the project was cancelled they were working on a 9,000 kg motor that was to produce 34,000 kgs of thrust for a thrust/weight ratio of 4:1.

The first NERVA was called Kiwi-A. The whole NERVA technology took one and a half billion dollars to develop—costs comparable to the research and devel-

opment expenses of the chemical propulsion systems—but the last NERVA engine was still a Kiwi.

The surface of our home planet feels a strong gravitational pull, and lies at the bottom of a deep potential energy well. Because the pull is strong, the mission step from Earth to orbit requires a motor with high thrust/weight ratio. Because the well is deep, the step from Earth to orbit is the dominating demand upon any mission in the inner Solar System. These two facts together prevent NERVA from opening the highroad to space.

NERVA atomic rockets are devices that carry graphite reactor engineering to amazing heights. They work once a *chemical rocket* puts them in orbit where thrust/weight is no longer so critical. For Mars-Jupiter runs they are demonstrably more economical to use than are oxygen-hydrogen systems, but there is NO way they can be modified to lift a payload off the Earth's surface.

If we have to rely on chemical rockets to get our NERVAs into orbit, the mission niches for which they were developed will not even exist for another fifteen or twenty years. Why, then, were they developed so soon, decades before they could be used?

The deep space assignment for NERVA reactors was an afterthought. The original nuclear rocket designs were proposed in 1955 to power ICBMs, and that is how the project got the money to get started. In 1955 the most rudimentary back-of-the-envelope thrust/weight calculations would have shown that no NERVA could ever have lifted an ICBM.

Let's look at a similar example from history. One hundred years ago man began to think in terms of powered aircraft. Enthusiasts tried to build light steam engines. The best they could do was fantastic—and would have powered an airplane on a planet with half Earth's gravity. They had no *engineering* failures; it was thinking in terms of *steam engines,* in terms of brass and boiling water, that was the "failure of imagination." We had to wait for dreamers who got excited about the internal combustion principle for our first usable aircraft engines.

The NERVA rockets, like steam engines, have intrinsic constraints on their power to weight performance which makes that particular variety of rocket ineligible as Earth-to-orbit boosters.

The very first thing you have to know about nuclear rocket design is that it is easy to attain high exhaust velocities but requires *engineering imagination* to attain high thrust/weight ratios. The second thing to remember is that in this case the payoff for imagination will be the large-scale opening of space.

AN ALTERNATIVE TO NERVA

The technology to build a nu-

Table 1:
COMPARISON OF NERVA AND DUMBO NUCLEAR ROCKET MOTORS

	NERVA	DUMBO
Geometric Factor	475 cm^{-2}	30,000 cm^{-2} to 100,000 cm^{-2}
Half Maximum Power Density	6 kwatts/cc	400 kwatts/cc to 1300 kwatts/cc
Thrust/Weight	4/1	50/1 to 100/1
Exhaust Velocity	6000 m/sec to 8000 m/sec	6000 m/sec to 9000 m/sec
Can Power Spaceship From Earth to Orbit	No	Yes

clear rocket in the thrust and weight category of the Saturn's F1, *with three to four times its exhaust velocity*, existed in the Sixties. The Atomic Energy Commission knew about it, and in fact financed its preliminary development at Los Alamos in the mid-Fifties.[1]

We did not get an atomic rocket motor with lift-off capabilities in the Sixties because the AEC opted to be conservative; they opted for a mild extrapolation of standard graphite reactors based on a proto-NERVA design which originated earlier at Oak Ridge.

This article will introduce you to a radical heat exchanger concept, applicable to high thrust/weight ratio atomic rocketry, which has never before been reported outside the classified literature. Its secret development flourished around 1958 and was eventually "deferred" in favor of the more familiar NERVA, as there were insufficient funds and manpower for two concurrent nuclear rocket programs.

In the classified literature this design was called Dumbo and I'll use that name to distinguish it from NERVA.

A COMPARISON OF TWO MOTORS

We need a concept by which we can "compare" NERVA and Dumbo, so I'll construct two mythical engines which deliver *half their maximal power output*, and build

one by NERVA specs and the other by Dumbo specs and see how they "perform." [2]

We'll let both engines run at 3,300 degrees Kelvin because that is near the top temperature we might expect from solid fuel elements made of carbides, graphite, or tungsten refractories, and because that temperature is very generous to the NERVA design. Dumbo fuel elements are by their nature *orders of magnitude* less sensitive to thermal stress than are NERVA type fuel elements.

The conductive transfer of heat is driven by a *temperature gradient.* Therefore *maximal* power would be developed by our engines if somehow we could arrange a temperature drop of the full 3,300 degrees, all the way down to absolute zero, but that would require an exhaust gas temperature of absolute zero and that is clearly not the way to run a rocket. Thus we decide instead to let our comparison engines deliver *half* their maximal power over a temperature drop of 1,650 degrees K, leaving an exhaust gas temperature of 1,650K which corresponds to an exhaust velocity of 6,300 m/sec at an expansion ratio of 200:1. A practical design would most probably aim for somewhat higher exhaust velocities with smaller temperature drops at the cost of a power level reduced to somewhat less than half maximum.

The power transferred in a heat exchanger is the product of (1) the thermal gradient at the surface of contact between the solid exchanger and the gas, (2) the coefficient of thermal conductivity at the contact surface, (3) the area of contact between gas and solid.

The thermal gradient we estimate as the quotient of a temperature drop and the length of the path from hot to cold. In fact the temperature drop comes in two steps: the drop from the site of power generation within the solid exchanger material to the surface of contact, and a further drop from the contact surface into the bulk of the gas. In practice almost all the temperature drop will be across one step or the other. We will not go far wrong by assuming in our power calculation that *all* the temperature drop is across the dominant step. Without a foreknowledge of which step dominates, we must do our power calculation twice, once for the solid and once for the gas. The lower result will be the proper one, as it will be the power which we can pull across the bottleneck in the heat transfer path.

Juggling the pieces: the half maximum power *density* is the product of three factors: (1) half the maximum safe temperature, (2) the material's thermal conductivity, (3) the *geometric factor* which is the contact area divided by the product of the thermal path length and exchanger volume. Watch that geometric factor—it is the one which

overloads the scales in favor of Dumbo and against NERVA.

A NERVA fuel element is a hexagonal bar 132 cm long, 1.9 cm in diameter perpendicular to the flat sides, pierced axially by 19 gas passages .25 cm in diameter so that the contact area is 1,970 square cms and the rod volume is 414 cubic cms. The heat travels an average distance of .047 cm inside the graphite giving a geometric factor of 100 per square cm for the solid exchanger.

We can assign a thermal conductivity of .3 watts/cm degree-K to the composite of pyrolytic graphite and UC·ZrC particles and thus get a one-half power density of 1,650 × .3 × 100 = 50,000 watts/cubic cm.

To do the corresponding calculation for heat exchange in the gas we must first determine the length of the heat flow path in the gas. This thermal path is across the boundary layer which separates the hot exchanger surface from the turbulent flowing bulk of the gas. For the operating conditions of NERVA the effective thickness of the boundary layer may be estimated by standard engineering formulae once we are given the mass-flow and the viscosity of the gas. We calculate a boundary layer of .01 cm in the gas. This boundary layer gives a gas geometric factor of 475 per square cm. The thermal conductivity of hot hydrogen is .008 watts/cm deg-K. Therefore the

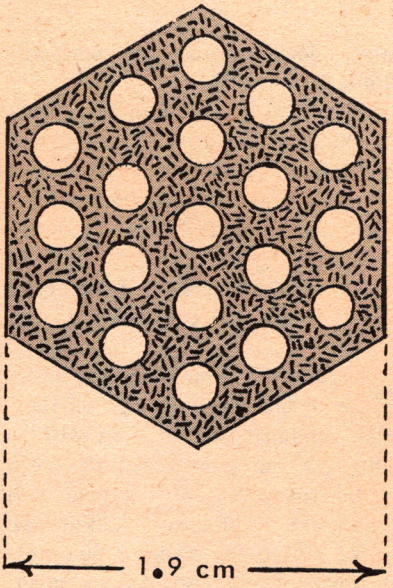

Figure 2: Cross-section of a NERVA Fuel Element. The fuel is a composite of pyrolytic graphite and particles of uranium carbide-zirconium carbide solution. The gas channels, coated with niobium carbide for protection against hydrogen erosion, are .25 cm in diameter and 132 cm long. Such an element generates one megawatt and each NERVA reactor contains about 1,500 of them.

one-half power density for the gas is 1,650 × .008 × 475 = 6,300 watts/cubic cm, showing us that the heat transfer bottleneck is within the gas. We conclude that with the finest engineering, NERVA fuel elements are bounded above by power densities on the order of 6,300 watts/cubic cm. Achieved power densities were about one half of this, due mainly to lower operating temperatures than 3,300K

and higher exhaust gas temperatures than 1,650K.

In principle the boundary layer might be reduced by increasing the mass flow. However, NERVA was a mature and well-optimized design; only a modest decrease in the boundary layer thickness would result from the diversion of the entire power output of the rocket to the pumps.

Nature sets limits on maximum material temperatures and on thermal conductivities, so if we wish to improve our power density to a point where we can compete with chemical combustion rockets we must design for a more favorable geometric factor. An obvious means for doing this is to increase the gas-solid contact area.

This cannot be done with a NERVA type design because if we add more and finer holes to the fuel element we add intolerably to the internal drag. Reducing the drag requires us to *shorten* the rod—which would lead to a disk-shaped reactor which is neither structurally nor neutronically sound. So we must depart from the NERVA-type reactor geometry in which gas flow through the exchanger is parallel to the axis of thrust.

Is there also some way we can increase the geometric factor by reducing the thickness of the boundary layer? We cannot afford to invest in astronomically powerful pumps, but we can make the gas passages so narrow that they are *thinner* than the boundary layer. Under these circumstances our heat exchanger will exhibit laminar flow rather than NERVA's turbulent flow. For a laminar flow heat exchanger nature imposes no limit on how short we can make the conduction path between the exchange surface and the flowing gas.

Let us return to the Los Alamos Dumbo design, mentioned previously, which was based on technology available in the 1950's. The fuel elements, actually made and tested, were constructed of uranium dioxide and tungsten cermet sandwiched within pure tungsten cladding. The gas flow path was one centimeter long. Individual plates were only .0025 cm thick, a flat plate alternating with a corrugated plate. The corrugations had a top to bottom magnitude of .015 cm and a wavelength of .075 cm. These elements did not evaporate or corrode after running for hours at temperatures above 3,300K while hydrogen flowed through them, nor

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A rule of thumb for computing the boundary layer thickness, which comes closer than a factor of 2, is $b = 1000yA/Mf$ *where b is the boundary layer thickness, y is the viscosity of hot hydrogen, about .0003 gm/cm-sec, A is the cross-sectional area of flow which is .93 square cm, and Mf is the mass flow: a NERVA fuel element at rated conditions throughputs 24 gms of hydrogen per second.*

Therefore $b = 1{,}000 \times .0003 \times .93 / 24 = .01$ *cm.*

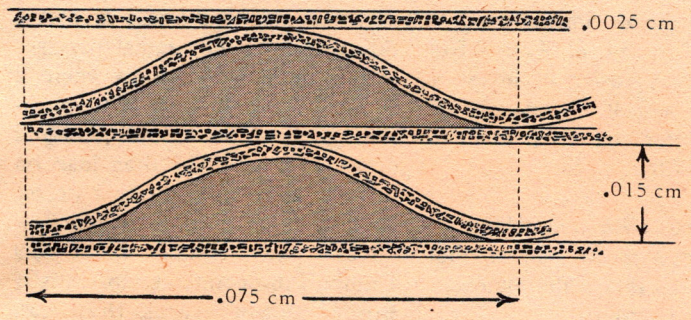

Figure 3: Cross-sectional Enlargement of Dumbo-type Fuel Element, c. 1958. The corrugation walls were tungsten-uranium dioxide cermet, cladded on both sides by pure tungsten. The gas passage length was one centimeter. A fine-toothed gear was used to roll out the corrugations. Today even finer structures are possible utilizing a variety of fabrication techniques.

did they break down under extreme and repeated thermal shock conditions—cycling back and forth *every second* over a range of 3,000 centigrade degrees for hours.

One of the early NERVA engineers held the first such micro heat exchanger in his hand and said quite calmly, "It is impossible to build this." That was in 1956. At that moment someone should have slipped him a Hewlett-Packard hand computer.

Because tungsten is a far better heat conductor than is hydrogen, the heat transfer bottleneck in Dumbo is in the gas, as it is in NERVA. The gas streamline furthest from the exchange surface is only .0075 cm away, and using that as the thermal path length we calculate a geometric factor of 30,000 per square cm. This gives a half maximum power of 1,650 × .008 × 30,000 = 400,000 watts/cubic cm.

Compare this one-half power density with NERVA's one-half power density. In its crude 1957 form a Dumbo fuel element has a power density 65 times as great as a NERVA fuel element even though its mass density is only twice as great as in NERVA. An engine with thrust/weight ratios comparable to chemical rockets could have been built around such micro-structured fuel elements.

The Dumbo design was shelved in favor of NERVA-type designs, not from arguments based on physics, but for essentially the same reason Western Union executives rejected Bell's telephone. Even when you *see* a major technological leap, even when it is demonstrated to you with working hardware, grasping it can be a greater step

than the ordinary imagination is capable of making. The AEC found it much easier to invest a billion and a half tax dollars in something safer and more familiar that wouldn't fly.

THE STRUCTURE OF DUMBO

A reactor is more than its fuel elements. Let's follow the hydrogen flow path in Dumbo.

First the gas cools the beryllium neutron reflector which encloses the motor. It must be cooled because it is being heated by gamma radiation and by neutron collisions.

Then the gas passes upward into a relatively cool space which surrounds a "forest" of tubes. These tubes have a porous "bark" of zirconium hydride which acts as neutron moderator. Zirconium hydride can hold almost the same hydrogen density as water and is stable up to 1,070K. It has functioned well as a moderator in several nuclear reactors designed to power satellites and has proved itself as a moderator in the Peewee reactor which was designed to test NERVA fuel rods.

The gas turns from its upward course and flows radially *into* the "trees" through this "bark" of moderator material. Once through the moderator, the gas finds itself on the inlet side of the main heat exchanger, cylinders of tungsten-UO_2 which nest within the cylinders of moderator.

Then the hydrogen flows, still perpendicular to the axis of rocket thrust, through fine radial passages in the tungsten-UO_2 walls where it is rapidly heated over a temperature gradient of several thousand degrees per cm. The drag load on the exchanger *falls to zero at the hot outlet*—the inside of the hollow "trees"—which is one reason why Dumbo can operate at substantially higher temperatures than can NERVA. In the Los Alamos experiments these exchangers were run for long periods with the outlet temperature all the way to the melting point of tungsten without any risk of failure.

Once through the fuel walls of the heat exchanger tube, the hydrogen is at full temperature and is free to descend into the nozzle.

At the power densities we are discussing, the steep thermal gradient does *not* tend to heat the cooler exterior of the tube which faces the moderator and the reason is not hard to see. The tendency of thermal conduction to carry heat energy back is overwhelmed by the tendency of the gas to sweep the heat energy forward with it to the hot surface of the exchanger. This phenomenon is called *dynamic insulation.* In effect it allows us to get hot gas from a cold exchanger. It permits Dumbo to operate in this risk-free manner down to some *minimum* power density.

A good criterion for this minimum power density is the operating condition in which the gas

carries forward twice the power that the thermal gradient conducts back. In the 1957 design the wall thickness, from cold to hot side, was one cm so that at full temperature we have a heat backflow of about 750 watts/square cm, compared with a forward flow of 400,000 watts/square cm. (In the calculation we have used a thermal conductivity of 1 watt/cm deg K for tungsten multiplied by a thermal gradient of 3,000 deg K/cm multiplied by .25 square cm, which is the fraction of the exchanger occupied by tungsten rather than gas.) This means that we can safely throttle down to 0.4 percent of the one-half maximum power level without overheating the moderator or load-bearing structures.

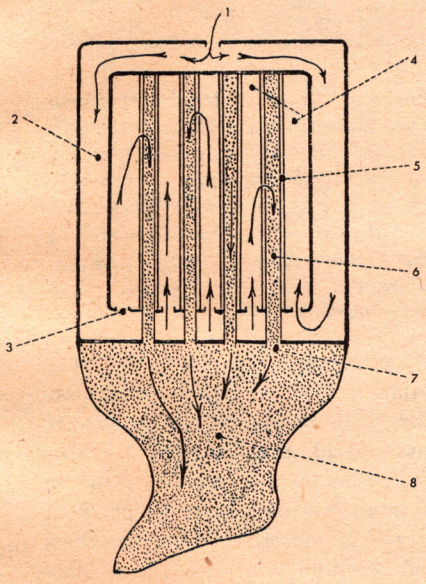

Figure 4: Schematic Dumbo Nuclear Rocket. (1) Hydrogen enters; (2) beryllium reflector; (3) a cold gas entrance; (4) cold gas surrounds tubes; (5) moderator coated tungsten-UO_2 tubes; (6) hot gas inside tubes; (7) hot gas exit; (8) hot gas in nozzle.

Because of this capacity to throttle down over such a wide power range Dumbo can deliver enormous initial power at some sacrifice of exhaust velocity while retaining the ability to operate at more modest powers—and higher exhaust velocities—for the later stages of the firing.

At 0.4 percent of the one-half maximum power, the gas temperature will be 3,293K with a corresponding exhaust velocity of 9,500 m/sec.

A remark on the history of the nuclear rocket program is appropriate here. Eventually a high-level directive was given which specified that the first complete Dumbo rocket motor should utilize the low-power nozzle already developed for the Kiwi-A. The effect was to impose an upper limit upon power which lay *below* the minimum power compatible with dynamic insulation. Apparently this was an oversight on the part of the decision-makers, who did not grasp the idea of dynamic insulation, but the directive was never reversed and the development of Dumbo began to lose momentum. Both

Dumbo and the entire nuclear rocket program were doomed by such critical decisions made early in the project when the decision-making was not in the hands of the people who understood the scientific basis of the program.

DESIGNING A DUMBO

Let us assume some modest technological changes since 1957 and put together a Dumbo design in the power and thrust/weight class of the F1 or the SSME, but of course with exhaust velocities in the 6,000 to 10,000 m/sec range.

Using figures, times four, from one of the rocket-type tungsten reactors assembled in Los Alamos[3] we see that we will have a core volume of one cubic meter which will require about 37 kgs of hydrogen and 843 kgs of zirconium for our neutron moderator. Such a core will use about 66 kgs of U-235 (as a dioxide) and 400 kgs of tungsten.

To complete our motor we need a neutron reflector around it. Because we wish to operate at extreme temperature conditions the reactor must be of the flat-neutron-flux, uniform-power-density type—we do not want hot spots because our materials will melt and we do not want cold spots because they will not heat our hydrogen gas sufficiently. These constraints put restrictions on our reflector.

"Reflector thickness must be so chosen that (neutron) buckling leakage from the reflector just balances capture in the core."[3] At Los Alamos such flat flux tungsten reactors with beryllium reflectors were assembled and brought to criticality. In these experiments with a minimum-sized reactor designed for a rocket motor, a 23-cm thickness of beryllium was needed to meet this condition.

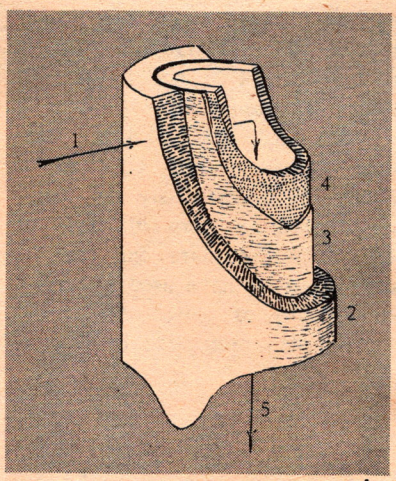

Figure 5: Detail of Dumbo Moderator Fuel Element Tube. (1) Cold hydrogen gas flows through (2) cylinder of zirconium hydride moderator, then through (3) very fine-holed "ballast" impedance, then through (4) fine radial channels in the uranium dioxide loaded tungsten, where it is heated, thence (5) gas passes down tube into nozzle.

The four-times-larger reactor we are considering would need a thinner beryllium reflector, but to get some approximation of the weight involved we use the larger figure. A 23-cm reflector surrounding a one-

cubic-meter core requires 3,500 kgs of Be.

Fuel elements, moderator, and neutron reflector give us approximately 5,000 kgs. To this we must add pumps, nozzle, et cetera. Since our motor will be roughly in the same class as Saturn's F1, let's just add the weight of the F1, 8,400 kgs, to it to take care of the extras. We'll assume a total motor weight of 14,000 kgs.

Crucial to this discussion is heat exchanger design. We have approximately 27,500 cubic cms of tungsten-UO_2 with which to build our fuel elements. Let us assume we can create a slightly finer structure than was done in 1957 when cog wheels were used to corrugate the tungsten foil. Fabrication methods have made gigantic strides since then. For instance, laser machining can rapidly cut out very fine structures. Assume a .0025-cm thickness for the UO_2 loaded tungsten as before and assume square gas passages .008 cm on a side. This gives us a geometric factor of 73,000 per square cm, and a void fraction of 58 percent.

Our half maximum power density is thus one megawatt/cubic cm, and since there are 65,000 cubic cms of fuel elements we have a half maximum power of 65,000 megawatts. This translates to a mass flow of 2,480 kgs of hydrogen per second and, assuming a chamber pressure of 100 atmospheres, a sea level thrust of 1.5 million kgs and a sea level exhaust velocity of 6,050 m/sec. The thrust/weight ratio would be 107:1. In contrast, the F1 delivers .7 million kgs of thrust at 2,500 m/sec with a thrust/weight ratio of 81:1.

The performance of this engine upon throttling can be seen in the following table. We are assuming a tungsten temperature of 3,300K, a chamber pressure of 100 atmospheres, and a nozzle expansion ratio of 200:1.

In NERVA the length of our gas passages is not under our control, they must be of approximately the same length as the diameter of the reactor core. In Dumbo we have much more flexibility in the choice of our gas passage length. The choice must be made on the basis of trade-offs among various performance features. In particular, we can make the passages long and make available a wide range of throttling conditions at the expense of a substantial pressure drop across the exchanger, or we can do the opposite.

It is not hard to calculate the pressure drop which accompanies the laminar flow of a viscous fluid through a channel, and if we choose a one-centimeter channel length, then the design we are discussing will show a pressure drop of six atmospheres at the half maximum power point. To this we must add another six atmospheres of pressure drop through a "ballast impedance" which precedes the

Table 2:
PERFORMANCE OF MODIFIED DUMBO DESIGN

Tg	2,000K	2,300K	2,600K	2,900K	3,200K
Td	1,300K	1,000K	700K	400K	100K
H	.010	.011	.012	.013	.014
P	62	52	40	25	7
Mf	1,876	1,310	840	438	99
Isp	713	772	834	893	956
V	6,980	7,560	8,150	8,750	9,360
Th	1.3	1.0	0.7	0.4	0.1

Tg is the gas temperature in Kelvin.
Td is the temperature drop driving the heat exchange.
H is the thermal conductivity for hydrogen in watts/cm deg-K averaged over the temperature drop.
P is the engine's power in billions of watts.
Mf is the mass flow of hydrogen in kgs/sec. (Liquid hydrogen has a density of .0708 kgs/liter or .27 kgs/gal.)
Isp is the specific impulse in seconds.
V is the exhaust velocity in meters/sec. V = Isp × 9.8.
Th is the thrust in millions of kgs. Th = Isp × MF.

heat exchanger and assures that the exchanger will not "chug" and operate cyclically as a heat-engine. (In the 1958 Dumbo design the ballast impedance was simply a nickel screen with fine photo-etched holes.) With this exchanger length dynamic insulation will be maintained until the motor is back-throttled to the point where the gas temperature is only three degrees less than the temperature of the exchanger outlet.

If instead we chose an exchanger passage length of two millimeters, then at half maximum power the pressure drop (exchanger plus ballast impedance) is only half an atmosphere and the motor may be throttled back until the gas temperature is 75 centigrade degrees below that of the exchanger outlet.

RADIOACTIVITY

If we are serious about using such rocket motors, we must face up to the side effects of nuclear technology. First of all, an operating nuclear reactor is a source of gamma radiation and we have fig-

ured no shielding penalties in our calculations above. Let us note, however, that the main cargo of a flourishing space program will be hardware rather than human biomass, and the heaviest pieces of hardware will tend to be the least delicate.

Already in the Skylab program it has proven effective to deliver the heavy equipment and the personnel with separate vehicles geared to the evidently different needs. It may well be that the current chemically-propelled Space Shuttle will be the most effective people-delivery system for decades to come, while heavy hardware is delivered by a high thrust nuclear rocket shuttle.

There remains the question of radioactive contamination. Some fission products may be released into the atmosphere during firing, an unpleasant thought. To get an idea of an upper boundary for this kind of contamination let us first assume that it is *all* dumped into the atmosphere. Nuclear bombs are measured in terms of tons of TNT. In these terms it would take "28 tons of TNT" in an 8,000 m/sec atomic rocket to put one ton of payload into synchronous orbit around the Earth.

Contamination on the magnitude of the Hiroshima A-bomb would put 700 tons of payload into such an orbit. That is eight Skylabs riding stationary in the sky. The 15-megaton U-bomb that rained radioactive fallout on a Japanese fishing crew in 1954 is the equivalent of enough trips to put 6,000 Skylabs into synchronous orbit.

But the contamination from Dumbo rockets could not possibly be that bad because there is no way for most of the fission residue to escape the tungsten cladding during the few minutes of flight while the vehicle is in or near the atmosphere.

The gas core nuclear reactor rocket which NASA is exploring, and the Orion scheme which envisions propulsion by sequential nuclear explosions, are both more attractive than Dumbo for eventual deep space applications as they promise exhaust velocities of 50,000 m/sec and up. However, contamination rules them out in any major Earth-to-orbit application. These schemes do not permit the retention of fission products and, with their higher 50,000 m/sec exhaust velocity, moving one ton to synchronous orbit would involve the release of radioactive contamination equivalent to "90 tons of TNT" rather than 28.

The production of fission products is at a minimum when the mission velocity is 1.6 times the exhaust velocity, and if exhaust velocity equals mission velocity that minimum is exceeded by only 11 percent. We note that the ratio between synchronous orbit mission velocity and Dumbo exhaust velocity falls within that range; consequently a solid heat exchanger

rocket is optimal for minimum fission contamination following any Earth-to-orbit flight.

APPLICATIONS

Once a spaceship is in Earth orbit it has climbed near the top of a huge energy well. From that platform the whole Solar System is close at hand in terms of "energy distance." The *major* expense is getting into orbit. On the Moon trips 95 percent of the mass of the Saturn rocket complex was devoted merely to getting the other five percent into orbit. It was that final five percent which picked up the extra two miles per second, went to the Moon, landed and came back. What space travel needs most of all right now is a cheap ground-to-orbit workhorse—which chemical fuels can never provide.

There are at present plans to reduce costs by the reuse of equipment. Thus we have the Space Shuttle concept. But the price is still huge, and the reason is that the system is enormously bulky. The Shuttle is three-fifths the size of the Saturn. It only looks smaller because the three stages are mounted in parallel rather than in a linear configuration. The first stage is still a massive, low exhaust velocity booster. The shuttle achieves one of its major equipment savings by making the second stage a fuel tank which feeds the reusable third stage motors.

But the shuttle concept never directly confronts the most cost sensitive rocket variable—the rocket's exhaust velocity. Several ambitious space projects must await the coming of a really high performance rocket motor.

The space factories will need it.

The Earth's demand for clean power may accelerate its development. Arthur D. Little, Inc. has studied the feasibility of a 10,000 megawatt Satellite Solar Power Station using solar cells in synchronous orbit which would generate electricity and microwave it down to antennae on Earth.[9] It is an elegant, permanent, and clean solution to the energy problem. The project has been judged brilliantly practical except for one thing—all known and projected chemical rocket delivery systems are too expensive by about a factor of four. That gap would be closed with ease by the equipment we have been discussing.

CONCLUSION

The purpose of this article is not to promote any particular nuclear rocket design, but rather to point out a general *philosophy of design* which would make the nuclear rocket the key to a cost effective space program.

That design philosophy centers on the high power needed to achieve the crucial step from Earth to orbit. The critical criterion is furnished by what we have called the *geometric factor.* Because of its

geometric factor the NERVA design failed and that failure could have been predicted.

To successfully furnish the critical step to orbit any future nuclear rocket must not only greatly exceed the geometric factor of NERVA, but must approach the geometric factor of the Los Alamos high power designs of 1957. ■

ABOUT THE AUTHOR

Donald Kingsbury is a lecturer in the Mathematics Department at McGill University in Montreal.

Analog readers may remember him as the author of a rather controversial article in our April 1955 issue, "The Right to Breed."

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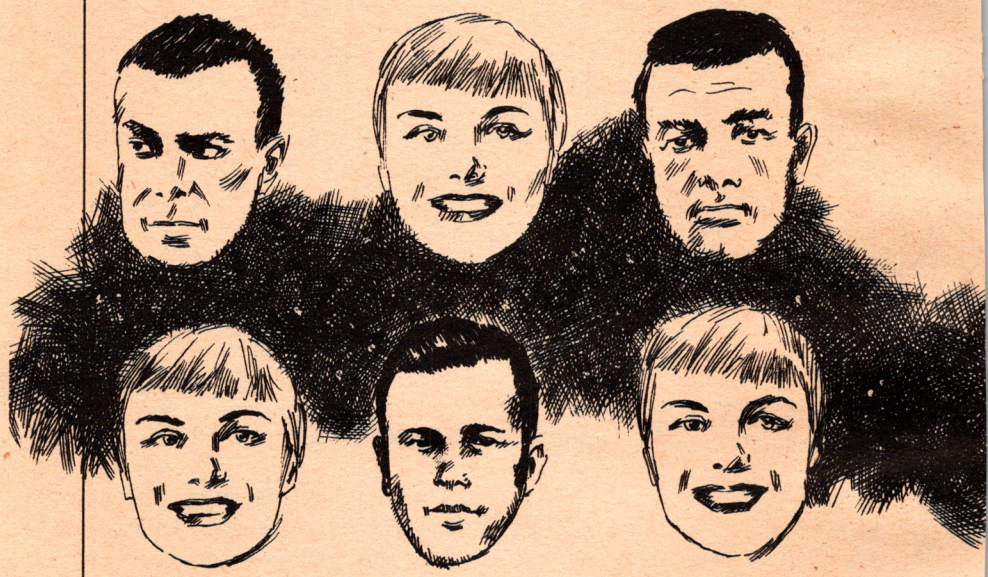
UNFAITHFUL RECORDING

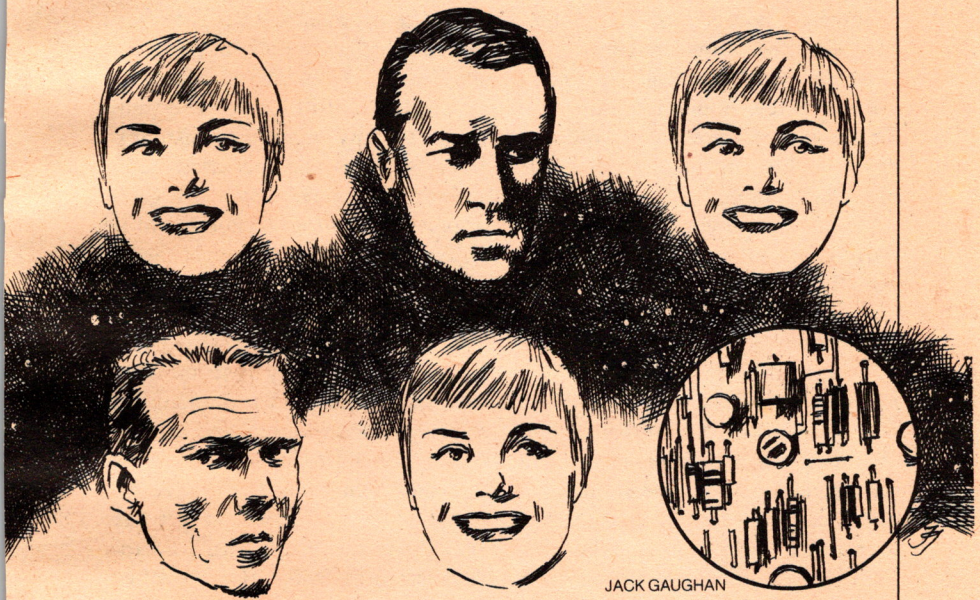
BOB SHAW

One definition of "living creature" is: "an entity that exhibits irritation."



"What you don't appreciate, Dave, is that I was *home* last night. With my wife. I was *there.*"

Hilliard leaned across the breakfast table as he spoke, pink face childishly solemn with conviction, his blue eyes imploring Surgenor to accept what he was saying, to share the joy which was so freely offered. Surgenor felt well-rested and well-fed, and therefore was in a mood to agree with almost anything—but there were problems. His mind fastened obstinately on the knowledge that their ship, the *Sarafand,* was making its way through a dense star cluster, more than twenty thousand light-years from Hilliard's home in Saskatchewan. There was also the obtrusive fact that young



Hilliard was not married.

Surgenor shook his head. "You dreamed you were home."

"You still don't get it!" Exasperation and evangelistic zeal caused Hilliard, who was normally quiet, to bounce in his chair. Men at the other end of the long table glanced curiously in his direction. The ship-day had just begun and the lighting panels in the semicircular room, typical of spacecraft living quarters, were glowing most strongly at the end designated "east."

"The experience of using a Trance-Port has little resemblance to dreaming," Hilliard continued. "A dream is only a dream, and when you're awake you recognize

the memories of it as dream memories. But with a Trance-Port tape you are *transported*, in the old sense of the word—that's the reason for the name—into another existence. The recollections you have next day are indistinguishable from other memories. I tell you, Dave, they are completely real."

Surgenor poured himself another cup of coffee. "But right now, this morning, you know you weren't in Canada a few hours ago. And you do know that you were bunked down in this ship on the other side of C-deck. Alone."

"Pinky was alone all right," Tod Barrow put in, winking at the others. "I tried to slip into his room for a good night kiss, but the door was locked."

"Incompatibility doesn't make a memory any less real," Hilliard said, ignoring the interruption. "What about all those times you were sure you had done something, like packing a toothbrush, and then found you hadn't? Even when it's been proved that you didn't pack the toothbrush you still go on 'remembering' how you did it. Same thing."

"Is it?"

"Of course it is."

"It all sounds a bit strange to me," Surgenor said doubtfully, taking refuge in his Oldest Member role, a part which was becoming easier to play with each new voyage he made for the Cartographical Service. The mapping crews seemed to get younger every year and to demand a degree of pampering which would have been unheard of when Surgenor had first signed on. In earlier days it had been accepted that there would be occasional periods of inactivity and boredom. These usually occurred during normal-space planetary approaches or when a ship got into a region which was so congested that the instantaneous drive could not be used to its full extent. The traditional therapy—mainly consisting of poker sessions and increased liquor rations—was one which Surgenor appreciated and understood, and he had viewed the recent experimental introduction of Trance-Port tapes without enthusiasm.

". . . big thing," Hilliard was saying, "is that they ease the pressure of loneliness. The human nervous system can only stand this sort of life for a strictly limited period, and then something has to give."

"That's why I tried to get into Pinky's room last night," Barrow said, grinning evilly. He was a first-tripper, a former computer engineer and an abrasive individual who made a profession out of being dark, hairy and masculine. From his first hour on the ship he had veen verbally sniping at Hilliard over the latter's baby-pink face and fuzz of blond hair.

"Shamble off and discover fire or something," Hilliard said to him casually, without turning his head. "I'm telling you, Dave, you can

only take it for so long."

Surgenor waved a confident denial with his cup. "I've been in the Service for over sixteen years—without any dream tapes to prop me up."

"Oh! Sorry, Dave. I wasn't implying anything. Honest."

The profuseness of the apology and the gleam in the youngster's eyes aroused Surgenor's suspicions. "Are you trying to get at me, junior? Because if you are . . ."

"Relax, Dave," Victor Voysey said from two places along the table. "We all know you're incurably sane. Bernie just wants you to try a tape to see what it's like. I'm using one myself this trip—got me a nice little Chinese firecracker of a wife I go home to most evenings. It's a good life, Dave."

Surgenor stared at him in surprise. Voysey had shared a two-man exploratory module with him for several years, on and off, and was building up a fairly respectable record of service. This was the first time he had mentioned going on to the tapes.

"You do it? You put one of those metal pie dishes under your pillow when you bunk down at night?"

"Not every night." Voysey looked slightly uncomfortable as he picked at his ham and eggs.

Surgenor felt his puzzlement increase. "You didn't tell me."

"Well, it isn't the sort of thing you go around talking about." An incongruous tinge of color appeared in Voysey's cheeks. "The Trance-Port programs give you a developing relationship with a nice girl, and it's sort of private. Just like it is in real life."

"*Better* than real life—you know you're going to score every time," Barrow said, making piston movements with his fist. "Tell us all about your Chinese piece, Vic. Is it like they say?"

"I wasn't talking to you."

Barrow was unabashed. "Come on, Vic—I'll tell you about my little woman. I only want to know if . . ."

"Shut it!" Voysey's face had turned pale as he picked up his fork and held it under Barrow's slate-gray chin. "I don't want to talk to you, and I don't want you to talk to me. And the next time you butt in on me I promise I'll do some permanent damage."

There was a taut silence, then Barrow got to his feet, muttering indignantly, and moved down the table to the other side of the small group. "What's the matter with him?" he whispered to Surgenor. "What did I say?"

Surgenor shook his head. He had no liking for Barrow, but Voysey's reaction had seemed unnecessarily violent. All Surgenor knew about the Trance-Ports was that they were triggered by the pressure of a man's head on the pillow, and worked largely by direct cortical stimulation of words and images.

Initially they produced a mild hypnosis which promoted sleep and then—after the brain rhythms had begun to indicate sleep, and when periods of rapid eye movement showed that the subject was ready to dream—fed his mind with a programmed scenario. Surgenor had always thought of Trance-Port players as a kind of advanced movie projectors, and therefore he was puzzled by the strength of the feelings they seemed to engender. He leaned towards Voysey, who was now staring down at his plate, but Hilliard caught his arm.

"Victor's right in what he says about it being just like real life," Hilliard said with a warning frown. "A Trance-Port isn't an erotic dream machine. The psychologists who program the tapes realize you need something more than that when you're this far away from home. A sexy girl is always the central figure, of course, but she's a lot of other things besides sexy. Warm. Understanding. Fun to be with, yet dependable. She provides you with all the things that Service life lacks."

"And she doesn't cost you a cent," Barrow said gleefully, apparently recovered from his brush with Voysey.

Hilliard was not put off. "She becomes very important to a man, Dave. I guess that's why anybody who is Trance-Porting doesn't talk about it much."

"You're talking some."

"I am, aren't I?" Hilliard smiled like a schoolboy discussing his first date. He lowered his voice to exclude Barrow. "It must be because I'm feeling so good. I never had an entirely satisfactory relationship with any of the girls back in Saskatoon. There was always something missing."

"Something missing?" Barrow said. "In your case it's easy to guess what." He glanced up and down the table, trying to enlist smiles, but he had made no friends since joining the *Sarafand* and the faces of the module crews remained impassive.

Hilliard, seizing the psychological moment, got to his feet and spoke in his best high-school declamatory style. "Barrow," he said solemnly, "if you had as much ability to hurt people as you have the desire, you'd be a deadly conversationalist indeed—as it is, you are merely pathetic."

There was an admiring whoop of laughter along the table. Hilliard acknowledged it with a dignified nod and sat down again, seeming oblivious to Barrow's look of hatred. Surgenor was pleased for the young man, but he had some misgivings about the developing situation which was another symptom of the strain felt by the *Sarafand's* personnel. The trip had already lasted longer than expected when it was discovered that Martell's Cluster had four more planetary systems than had been indicated by

long-range examination. It was within the discretion of Captain Aesop—the computer which controlled the big ship—to reject the four extra surveys, but Aesop had decided to press on. Surgenor, filled with an uncharacteristic wish to reach Earth in time to spend Christmas with his cousin's family, had voiced objections, only to have them dismissed. Now, with tension building up around the breakfast table, he decided to have another private interview with Aesop.

"Things are different now that I've met Julie," Hilliard said.

"Julie? You mean, they have names?"

"Of course, they have names!" Hilliard covered his face with his hands for a few seconds. "You just don't understand, do you, Dave? Real girls have names, so Trance-Port girls have names. Mine happens to be called Julie Cornwallis."

At that moment Surgenor became aware of two simultaneous events. Aesop spoke to the crew on the general address system, telling them that he had assessed all gravitational forces acting on the ship and therefore was about to make a beta-space jump closer to the heart of Martell's Cluster. And, while the omnidirectional voice of the computer was flooding the room, the face of Tod Barrow—which had been filled with a broody resentment—suddenly registered surprise and happiness. The look was quickly gone, and a few minutes later Barrow left the table.

The incident was less than trivial, and Surgenor forgot it as the module crews abandoned the table and crowded into the dimness of the observation room on the same deck. He went with them, moving with a casual stride which befitted a veteran of many such jumps, yet contriving to be among the leaders. Watching the Instant Distance drive in action, seeing the star fields abruptly shift and knowing he had covered light-years with the speed of thought, was an experience Surgenor could never regard as commonplace. The observation room had twelve swivel chairs—one for each member of the ship's company—which were grouped midway between two hemispherical viewing screens. Forward was a view through the center of Martell's Cluster. The curved screen was like a bowl of black champagne, frozen, with a thousand silver bubbles checked in their flight by the briefness of man's existence. Surgenor waited for the jump, trying to feel it happening, even though he knew that any process which was slow enough to be perceived would probably be fatal. On the instant, with no sense of anything having moved, the disk of a new sun appeared and seemingly drove other stars outwards.

"We've arrived," Clifford Pollen said, acknowledging the fact that Aesop had taken them right into the target system. The next few

weeks would be occupied by normal-space approaches to its constituent planets and, where feasible, direct examination by the survey modules. Depending on how things went, the *Sarafand* could spend a full month in the system, and there were three others yet to be visited. Surgenor looked at the alien sun and thought about the precious fleeting afternoons of winter on Earth, about football matches and cigar stores and women at supper tables, and about the deep comforts of families drawing together at Christmas. And he knew that Aesop was wrong, that the voyage should not have been extended. He stood up without speaking and went to the island of privacy which was his room. Not bothering to lock the door—a rule of shipboard life was that no crewman ever entered another's quarters—he sat down and closed his eyes.

"Hear these words," he said presently, using the code phrase which put any member of the ship's company on line to the computer.

"I'm listening to you, David" Aesop said mildly, voice accurately beamed to Surgenor's ears.

"It was a mistake to include four extra system surveys in this mission."

"Is that an opinion? Or are you in possession of data which have not been made available to me?" A dryness had crept into Aesop's voice and Surgenor was almost certain that the choice of words constituted sarcasm, but he had never been able to find out the exact degree of verbal subtlety of which Aesop was capable.

"I'm giving you my assessment of the situation," he said. "There's a lot of tension building up in the crew."

"That is predictable. I have made allowances for it."

"You can't predict how human beings will react."

"I did not say I could predict their reactions," Aesop said patiently. "I can assure you, though, that I weighed every important factor before making my decision."

"What factors?"

There was a barely perceptible pause, an indication that Aesop considered the question a stupid one, before the computer spoke. "The volume of space explored by the Cartographical Service is roughly spherical. As the radius of this sphere increases, its surface area . . ."

"I know all that stuff," Surgenor interrupted. "I know the job gets bigger all the time and that there's an economic pressure to extend the missions. I was asking about human factors."

"Apart from the body of general psychological data available to me, I can refer you to the relevant abstracts from Mission Final Reports for the past century. Those of the Cartographical Service alone oc-

cupy some four million words; military records, more extensive because of the nature of the activities, run to nine million words; then there are the reports of the various civilian agencies which . . ."

"Forget it." Surgenor, aware that he was being outmaneuvered, decided to try a different approach. "Aesop, I've been with you on the *Sarafand* a long time, long enough to start thinking of you as a human being, and I believe I can speak to you just as one man would talk to another."

"Before you begin, David, will you answer two questions?"

"Of course."

"One—what gave you the curious notion that I would be subject to flattery? Two—where did you get the even more curious idea that ascribing human attributes to me could possibly be construed as flattery?"

"I have no answers to those questions," Surgenor said heavily, defeated.

"That is a pity. Proceed."

"Proceed with what?"

"I'm ready for you to speak to me as one man would talk to another."

Surgenor did exactly that for almost a minute.

"Now that you have relieved your mental stress," Aesop commented at the end of the outburst, "please be reminded that the correct code phrase for verbal disengagement is 'Hear me no more'."

Surgenor tried for a final obscenity as the audio connection was broken, but his imagination failed him. He prowled around the room for a while, forcing himself to accept the realization that there was no way of getting back to Earth by Christmas, then went down to the hangar deck and began carrying out systems checks on his survey module. At first he found it difficult to concentrate, but then his professionalism took over and several hours went by quickly. The light panels at the "noon" section of the circular deck were glowing brightest, giving the impression of a midday sun beyond, when he emerged from the vehicle and went to lunch. He sat down beside Hilliard.

"Where have you been?" Pollen said.

"Checking out my sensor banks."

"Again?" Pollen raised one eyebrow in amusement.

"It keeps him out of mischief," Hilliard said, winking at the others.

"I've never had to backtrack halfway 'round a planet," Surgenor replied, reminding Pollen of an incident he was anxious to forget, and specified his meal on the menu buttons. His soup had just emerged from the dispensing turret when Tod Barrow came into the mess and, after surveying the table, sat down opposite him. Barrow, who had evidently been working out in the gymnasium, was wearing a track suit and smelled of fresh sweat. He greeted Surgenor with unexpected joviality.

Surgenor gave him a slow nod. "Is the shower unit out of action?"

"How would I know?" Barrow looked innocently surprised at the question.

"People usually go in there after a workout."

"Hell, only dirty people need to keep washing themselves." Barrow's slate-gray features creased in a grin as his eyes fixed on Hilliard. "Besides, I was in the tub last night. At home. With my wife."

"Not another one," Surgenor muttered.

Barrow ignored him, keeping his gaze on Hilliard. "Real fancy tub, it is. Gold. Just matches my wife's hair."

Surgenor noticed that Hilliard, beside him, had set down his fork and was staring at Barrow with a peculiar intensity.

"Her skin's sort of gold-colored, as well," Barrow continued. "And when we're in the tub together she ties her hair up with a gold ribbon."

"What's her name?" Hilliard said, surprising Surgenor with the question.

"Even the faucets are gold on that tub. Gold dolphins." Barrow's face was ecstatic. "We shouldn't really have bought it, but when we saw it in . . ."

"What's her name?" Hilliard's chair tumbled behind him as he jumped to his feet.

"What's the matter with you, Pinky?"

"For the last time, Barrow—tell me her name." Red beacons of anger burned in Hilliard's cheeks.

"It's Julie," Barrow announced contentedly. "Julie Cornwallis."

Hilliard's jaw sagged. "You're a liar."

"I ask you," Barrow said to the others who are watching the incident, "is that any way to speak to a shipmate?"

Hilliard leaned across the table towards him. "You're a bloody liar, Barrow."

"Hey, Bernie!" Surgenor stood up and caught Hilliard's arm. "Cool off a little."

"You don't understand, Dave." Hilliard shook his arm free. "He's claiming he's got a Trance-Port tape the same as mine, but they don't do that. They make sure there's only one of each type on a ship."

"They must have made a mistake," Barrow said, chuckling. "Anybody can make a mistake."

"Then you can turn yours in and get a different one."

Barrow shook his head. "No chance, Pinky. I'm happy with the one I got."

"If you don't turn it in I'll . . ."

"Yes, Pinky?"

"I'll . . ."

"My soup is getting cold," Surgenor said in his loudest voice. He was a big deep-chested man and could produce an awe-inspiring bellow when he judged it necessary. "I'm not going to eat cold

soup for anybody—so we're all going to sit here quietly and take our food like grown-ups." He picked up Hilliard's chair and pushed the younger man into it.

"You don't understand, Dave," Hilliard whispered. "It's as if my home had been invaded."

For a reply, Surgenor pointed at his soup and began to spoon it up in silent concentration.

In the "afternoon" Surgenor finished reading a book, spent some time in the observation room, then went to the gymnasium and practiced fencing with Al Gillespie. He saw nothing of Hilliard or Barrow, and if he thought about the incident of the Trance-Port tapes at all it was only to congratulate himself on having forced some sense into the two men concerned. Peaceful red-gold light was flooding through the "western" end of the mess when he entered and sat down. Most of the places were filled and the dispensing turret was busy whirring up and down the table's central slot. The lively atmosphere would normally have made Surgenor feel cheerful, but this time it reminded him of the Christmas he was not going to have on Earth. He dropped into a chair, called up a standard dinner and was eating without much pleasure when he became aware of a latecomer sitting down beside him. His spirits sank even further when he saw it was Tod Barrow.

"Sorry I'm late, men," Barrow said, "but I see you've started without me."

"We took a vote on it," Sig Carlen growled, "and decided that was what you would want us to do."

"Quite right." Barrow stretched luxuriously, immune to sarcasm. "I was dozing most of the afternoon, so I decided to go home. To see my wife."

There was a groan of complaint from the assembly.

"That Julie is some girl," Barrow continued, heedless, closing his eyes the better to savor his memories. "The way she dresses you'd think she was a Sunday school teacher or something—but what a line in undies!"

Somebody at the other end of the table gave an appreciative guffaw. Surgenor glanced around, looking for Hilliard, and saw him sitting with his head bowed. There was a rigid stillness about the young man which Surgenor did not like.

Surgenor leaned closer to Barrow. "Why don't you give it a rest?"

Barrow waved a dismissive hand. "But you've got to *hear* this. You know those new vibrator brassieres? Well, my Julie has a habit of . . ." He stopped speaking and a grin spread over his face as Hilliard jumped to his feet and ran from the room. "Aw, look at that! Young Pink's gone and left us, just

as I was getting to the good bit—perhaps he's gone to warn Julie about two-timing him." More laughter greeted the remark and Barrow looked gratified.

"You're laying it on too thick," Surgenor told him. "Leave the kid alone."

"It's only a joke. He should be able to take a joke."

"You should be able to make one."

Barrow shrugged and, apparently satisfied at having revenged himself on Hilliard, scanned his menu display. He ordered clear soup and took it slowly, pausing every now and then to shake his head and chuckle. Surgenor tried to suppress the anger he felt at Barrow for being such a disruptive influence, at Hilliard for allowing himself to get so worked up over nothing more than a piece of dream tape, at the Service authorities for issuing the Trance-Ports in the first place, and at Aesop for prolonging the trip beyond its normal term. The effort stretched his tolerance to the limit.

He was toying with the remains of his meat loaf when the conversational hum in the room faded away. Surgenor looked up and saw that Bernie Hilliard, unnaturally pale, had come back into the room. The young man walked around the table and came to a halt beside Barrow, who twisted in his chair to look up at him.

"What's on your mind, Pinky?" Barrow seemed slightly taken aback by the new development.

"That soup you're eating looks a bit thin," Hilliard said woodenly. "What do you think?"

Barrow looked puzzled. "Seems all right to me."

"No. It's definitely too thin—try some noodles." Hilliard produced a tangle of silver-and-green tape from behind his back and slapped it down into the other man's soup.

"Hey! What is this?" Barrow stared at the knotted mass and suddenly was able to supply his own answer. "That's a Trance-Port tape!"

"Correct."

"But . . ." Barrow's eyes shuttled as he reached an inevitable conclusion. "It's *my* tape!"

"Right again."

"That means you went into my room." Barrow sent a scandalized glance around the other men, making them witnesses to the confession, then he leaped at Hilliard's throat. Hilliard tried to twist free and both men fell to the floor, with Barrow uppermost.

"You shouldn't . . . have gone . . . into my room!" Still holding Hilliard by the throat, Barrow punctuated his words by banging the young man's head against the floor.

Surgenor, who had risen from his place, lifted one foot and stamped it down hard between Barrow's shoulder blades. Barrow collapsed like a pile of sticks and lay on his

side, gasping, while Surgenor and Voysey picked Hilliard up.

"Do me a favor, Bernie, for God's sake," Surgenor said. "Try to unscramble your brains."

"Sorry, Dave." Hilliard looked shaken, but triumphant. "He had no right . . ."

"You had no right to go into his room—that's one thing you just don't do shipboard."

"Yeah, how about that?" Barrow put in, struggling to his feet. "He violated my privacy."

"Not as much as you violated mine," Hilliard said.

"It was *my* tape." Barrow turned and lifted the dripping tangle. "Anyway, a smear of soup won't do it any harm. I'll clean it and feed it back in the cassette."

"Go ahead," Hilliard paused to smile, "but it won't do you any good. I wiped it first."

Barrow swore and moved towards Hilliard again, but was pushed down into his chair by several men acting in concert. Surgenor was relieved to see that the general weight of opinion was against Barrow—a situation less likely to get out of hand than one where there were two evenly matched sides. Barrow surveyed the ring of unfriendly faces for a moment, then gave an incredulous laugh.

"Look at them! All screwed up over nothing! Relax, men, relax." He dropped the green-and-silver tape back into his soup and pretended to spoon it into his mouth. "Hey, this is good stuff, Pinky—I think you found the best thing to do with these stinking Trance-Ports."

A number of men laughed, and there was an immediate easing of tension. Barrow clowned his way through the rest of the meal, giving an excellent impression of a man who was incapable of bearing a grudge. But Surgenor, watching him closely, was unable to accept it as anything but an impression.

"Hear these words," Surgenor said to the quietness of his room.

"I'm listening to you, David."

"Things are getting worse."

"That statement is too generalized to have any . . ."

"Aesop!" Surgenor took a deep breath, reminding himself there was no point in getting angry at a computer. "I'm talking about the psychological stress on the survey crews. The signs of strain are becoming more pronounced."

"I have observed pulse rates going up and skin resistance going down, but only on isolated occasions. There is no cause for alarm."

"No cause for alarm, he says." A new thought struck Surgenor. "Supposing there was cause for alarm, suppose things really started getting out of control—what could you possibly do about it?"

Aesop's voice was peaceful. "I could do many things, David, but the indications are that adding a simple psychotropic drug to the

drinking water would be quite sufficient."

"You're empowered to trank human beings any time you feel like it?"

"No—only when they feel like it."

Again, Surgenor was almost certain Aesop was laughing at him. "Even that's too often for my liking. I wonder how many people know about this."

"It is impossible to compute how many people know, but I can give you a relevant piece of information."

"Which is . . .?"

"That—no matter how many more you decide to tell—you will not be back on Earth by Christmas."

Surgenor stared coldly at the speaker grill on the wall of his room. "Read me like a book, did you?"

"Not really, David—I find books quite difficult to read."

"Aesop, do you know you have a nasty supercilious streak?"

"The adjectives are inapplicable in my . . ." Aesop broke off in mid-sentence—something Surgenor had never known him do before. There was a pause, then the voice returned, more rapid now and charged with designed-in urgency "There is a fire on the hangar deck."

"Serious?" Surgenor grabbed for his boots and began pulling them on.

"Moderate concentration of smoke, but I detect only a localized blaze and there are no electrical short circuits registering. The situation appears to be well within the capacity of my automatic systems."

"I'll go down and have a look," Surgenor said, relaxing a little as the specter of a major catastrophe receded. He left the room and ran to the main companionway which was crowded with other men who were anxious to find out what had happened. The circular hangar deck was hazed with oily drifting smoke which obscured the outlines of the six survey vehicles in their stalls, but even as Surgenor entered he could see that it was being efficiently drawn into the ceiling grills. In little more than a minute the smoke had vanished except for stray wisps arising from a box on one of the workbenches.

"I have turned off the fire-control sonics," Aesop announced. "Complete the extinction manually."

"Look at this." Voysey got to the workbench first and picked up a small laser knife which was lying with its projection head pointing at the smouldering box which contained oily waste. "Somebody left this cutter switched on low power." He studied the tool curiously. "This thing's dangerous. The range limit is broken—that's what started the fire."

While one of the men broke out a fire-control grenade and fumed it into the box, Surgenor took the

cutter from Voysey and examined it. The range control plate had been twisted completely out of line in a way which, to him, did not look accidental. Another odd fact was that the waste box with the charred hole in its side invariably sat on the floor with clamps securing it to the leg of the bench. It was almost as if somebody had started the fire deliberately, but that was something no sane person would do. A spaceship was a machine for keeping human beings alive against all the dictates of nature, and it was unthinkable that anybody should try to damage the machine . . .

"I guess we were lucky," Voysey said. "There's no harm done."

Aesop spoke immediately. "That remains to be seen, gentlemen. The hangar deck was in the clean air condition for electronics maintenance on Modules One, Three and Six. All exposed units will have to be inspected for contamination, then cleaned and given function checks. I suggest that you begin work on them now—otherwise there could be delays in the forthcoming survey."

Groans of protest went up from the assembly, but Surgenor fancied that most of the men were pleased at having some genuinely necessary task to perform. It created a break in the shipboard routine and gave them a comforting sense of being useful. He joined in the work, putting aside his speculations about the origins of the fire, and spent two hours engrossed in checking out electronics packs. The survey modules were designed for repair by replacement so that relatively untrained men could keep them operational, but, in spite of that, the job of changing major components was one which demanded concentration.

By the time the evening meal came around Surgenor was pleasantly tired. He was relieved, therefore, when it passed off without any trouble between Hilliard and Barrow. After they had eaten, most of the complement watched a holoplay. Surgenor had two large whiskeys, found himself growing dangerously nostalgic about Earth at Christmas, and went to bed early.

He awoke in the morning, relaxed, filled with the knowledge that it was Saturday and that he would not be going to his office. The design he was producing for the new university auditorium was at a fascinating, mind-devouring stage, but he knew from experience that a weekend of complete rest would enable him to return to the project at an even higher pitch of enthusiasm and efficiency. Contentment filled his mind like the chiming of silver bells as he turned in the bed and reached for Julie. There was a momentary disappointment as he discovered her place was empty, then he became aware of the aroma of brewing cof-

fee drifting upstairs from the kitchen. He got up, stretched, and padded naked into the bathroom and looked at the tub with its taps in the shape of gold dolphins. He decided against having a bath and turned on the shower. Cherry blossoms gleamed like sunlit snow beyond the bottle-glass windows.

"Dave?" Julie's voice was faint above the sound of the water. "Are you up? Want some coffee?"

"Not yet." Surgenor smiled to himself as he stepped into the jetting warmth of the shower cubicle. "There aren't any towels up here," he called. "Can you bring me one?"

A moment later Julie came into the bathroom with a towel. She was wearing a yellow robe, loosely tied, and her gold hair was drawn back with a gold ribbon. The beauty of her filled Surgenor's eyes.

"I was sure . . ." Julie stopped speaking as she glanced around the bathroom and saw the plentitude of towels on their rails. "Oh, Dave! What's the idea of bringing me all the way up the stairs?"

Surgenor grinned at her. "Can't you guess?"

She ran her gaze over his taut body. "The coffee's ready."

"Not as ready as I am. Come on in—the water's lovely."

"Promise not to get my hair wet?" she said, pretending the reluctance which was only part of their love games.

"I promise."

Julie untied her robe, let it slide back from her shoulders and onto the floor. She stepped into the shower with him. Surgenor took her in his arms and in the minutes that followed he purged himself of all the desire, all the loneliness a spaceflier is fated to accumulate in his wanderings.

Later, as they were seated at the breakfast table, he felt a strange thought growing unbidden in his mind: *If I'm an architect, if I really am an architect, how can I know so much about the way a spaceman feels?*

He stared at Julie in a kind of sad puzzlement, and became aware of a soft pressure at the back of his neck. It felt exactly like a pillow. He raised his head, blinked uncomprehendingly at the sparse furnishings of his room on the *Sarafand's* C-deck, then threw his pillow aside. Underneath was the flat silvery disk of a Trance-Port tape player.

Surgenor had almost reached the door of the mess when he felt himself being pushed aside. He turned and saw Victor Voysey, whose face was angry and abnormally pale. Surgenor began to protest, then he noticed the other man was also carrying a Trance-Port tape disk.

"What's the matter, Victor?" he said, his mind still blurred with the images of the night.

"Somebody switched tapes on me, that's what's the matter. And I'll kill the bastard when I find out

who he is." Voysey was breathing heavily.

"Switched tapes on you?"

"That's what I said. Somebody went into my room and took my own tape and put a different one in the player."

Surgenor felt the coolness of premonition. "What tape did you get?"

"I think it was young Hilliard's. The girl seemed . . ." Voysey stopped speaking as he noticed the disk in Surgenor's hand. "What's going on here? I thought you didn't use them."

"I don't—but the joker slipped one under my pillow anyway."

"Then it must have been mine."

"No. It was Hilliard's."

Voysey looked baffled. "But there should only be one of each."

"So I'm told." Surgenor opened the door and they went into the mess. Most of the crew were already there, standing in a knot at the "east" end of the room, but Surgenor's gaze was drawn to the scattering of silvery disks on the table.

"Hi, Dave, Victor," Pollen said. "I see you've been done as well—welcome to the club."

"How did you like the gang bang?" Gillespie asked, chuckling.

Lamereux glared at him. "This isn't funny, Al. I don't use the tapes, but somebody went into my room, into my *head*—and I don't like it."

"If everybody got the same sequence, then somebody must have taken Bernie Hilliard's tape from his room and made a dozen or so copies."

"I thought the cassettes were designed to prevent copying."

"They are, but a man with the right experience could do it."

"Who?"

Surgenor glanced around the room. One man had stayed apart from the discussion and was seated at the table, studiously unconcerned, taking a platter of ham and eggs from the dispensing turret. Surgenor went over to him, with the others following.

"You went too far, Barrow," Surgenor said.

Barrow raised his eyebrows in polite surprise. "I've no idea what you're talking about, old son."

"Leaving aside the whole invasion of privacy bit, I'm going to report you for maliciously starting a fire on board ship. You'll do time for that."

"*Me!*" Barrow looked indignant. "I never started any fire. Why should I?"

"To get everybody down in the hangar so that you could steal Bernie's Trance-Port and copy it and slip it into all the rooms."

"You're crazy," Barrow sneered. "Next time you make an accusation like that, get yourself some proof."

"I'll get proof this time," Surgenor told him. "Aesop monitors all our movements, continuously, only it's written into our contracts that

the recordings will never be played unless it's a matter of ship safety or a criminal investigation—and this comes under both headings. I'll call him up now."

"Wait a minute!" Barrow stood up, spread his hands and put on one of his slate-gray smiles. "I'm no criminal, for God's sake. Can't you guys take a joke?"

"*Joke!*" Voysey pushed by Surgenor and grabbed two handfuls of Barrow's shirt. "What did you do with my own tape?"

"I put it away safe for you. Take it easy, will you?" Barrow had begun to look nervous.

"Let him go—that doesn't solve anything," Surgenor said, noting with a sense of surprise that Voysey's main concern seemed to be for the safety of his Trance-Port.

Barrow smoothed out his shirt when he was released. "Look, fellows, I'm sorry if I upset you. It was only . . ."

Voysey was not satisfied. "What the hell was the idea? Why did you do it?"

"I . . ." Barrow stopped speaking and a gleam of triumph was kindled in his eyes as Bernie Hilliard came into the room. Hilliard looked pink, relaxed and happy.

"Sorry I'm late, men," he said. "I was having such a good time I just didn't want to wake up this morning. What's going on here, anyway?" He glanced curiously around the group.

"Something you ought to know about," Voysey rumbled. "Our shipmate Barrow, here . . ."

Surgenor caught his arm. "Wait a minute, Victor."

Voysey shook himself free impatiently. ". . . went into your room yesterday, took your Trance-Port, made a dozen copies of it and slipped it under all our pillows. We all got it last night. That's what's going on."

Hilliard flinched as though he had been struck and the color faded from his cheeks. He stared at Barrow, who was nodding eagerly, and then turned to Surgenor.

"Is this true, Dave?"

"It's true." Surgenor glanced into the boy's eyes, thought of Julie as she moved her nakedness against him beneath the warm jets, and turned his gaze away, guilty and embarrassed. Hilliard looked around the rest of the group, shaking his head and moving his lips. The others shuffled their feet, unwilling to face him.

"I did you all a favor," Barrow said. "A girl like that Julie *ought* to be public property."

Voysey stepped behind Barrow and, with an abrupt movement, pinned Barrow's arms. "Come on, kid," he said to Hilliard. "Wreck his face. He deserves it."

Barrow struggled to get free, but Voysey held him easily while a bleak-eyed Hilliard moved closer and bunched his knuckles. Surgenor knew he should intervene, yet found himself unwilling to do so.

Hilliard measured his distance with ritual slowness, drew back his fist, hesitated, and then turned away.

Voysey pleaded with him. "Come on, kid—you're *entitled.*"

"Why should I?" Hilliard's lips stretched into a smile which was anything but a smile. "Tod's right in what he says—a guy would be real mean if he didn't want to share a good whore with his friends."

But Julie's not like that! The protest was in Surgenor's mind, and he had almost spoken it, when he realized he was on the verge of making a fool of himself. They were not talking about a real woman, only a complex of patterns on a magnetic tape.

"Let the man go," Hilliard said, taking a seat at the table. "Now, what's for breakfast? After the night I had I need some solid nourishment inside me. Know what I mean?" He winked at the man nearest to him. Surgenor looked at him with a sudden and irrational dislike, then turned back to Barrow.

"You're not getting away with this," Surgenor said, and—filled with a rage he did not want to acknowledge or understand—he left the mess and headed for the solitude of his room.

"Hear these words."

"I'm listening to you, David."

Surgenor lay still on his bed, marshaling his thoughts. "I'm reporting to you, officially, that the fire on the hangar deck yesterday was started by Tod Barrow. Deliberately. He has just admitted to doing it." Surgenor went on to describe the subsequent events as objectively as he could.

"I see," Aesop commented when he had finished. "Do you think there will be more trouble between Barrow and Hilliard?"

"I . . ." Surgenor considered building another case for aborting the mission, but similar arguments had always failed with Aesop. "I don't think so. It seems to me they've burned themselves out."

"Thank you, David." There was a brief silence, then Aesop said, "You will be interested to learn that I have decided to terminate the mission. That means you can be back on Earth before the twenty-fifth of December, as you wished."

"What?"

"You will be interested to learn that I . . ."

"Don't go over it again—I got you." Surgenor sat up on the bed, almost afraid to believe what he had heard. "What made you change your mind?"

"The circumstances have changed."

"In what way?"

There was another silence. "Barrow is more unpredictable than you think, David."

"Go on."

"He has interfered with my

memory and logic. In my judgment it is necessary for me to return to Earth in order that certain readjustments, which are beyond my capabilities, can be carried out."

"Aesop, I don't understand you." Surgenor stared at the speaker grill on the wall. "What did Barrow do?"

"He made an extra copy of Hilliard's Trance-Port tape, and fed it into my main data input."

The words were almost an obscenity to Surgenor. "But . . . I didn't think that sort of thing was possible."

"To a properly qualified man it is. In the future the Cartographical Service will place an upper limit on the amount of experience survey crew members can have in certain fields. Also, they will probably discontinue the Trance-Port experiment."

"This is weird," Surgenor said, still trying to grasp the implications of the situation. "I mean, was the tape even compatible with your internal languages?"

"To a large extent. I am very versatile, which in this case was an area of vulnerability. For example, I have decided to abort this mission . . . but I am not entirely certain that my decision was based on logic."

"It seems perfectly logical to me—somebody as dangerous as Barrow needs treatment as soon as possible."

"Correct, but the fact that I am alert to him vastly reduces his potential for harm. It may be that I now understand your desire to return home, and am being influenced by it in a nonlogical manner."

"That's highly unlikely, Aesop. Believe me, this is one subject on which I'm better informed than you." Surgenor got to his feet and walked to the door of his room. "Do you mind if I break the news to the men before you speak to them?"

"I have no objections, as long as you do not discuss the real reasons for the decision."

"I won't." Surgenor was opening the door when Aesop spoke again.

"David, before you go . . ." The disembodied voice was strangely hesitant. ". . . the data on Hilliard's tape . . . is it an accurate portrayal . . . of the human male-female relationship?"

"It's highly idealized," Surgenor said slowly, "but it can be like that."

"I see. Do you think Julie really exists somewhere?"

"No. Only on tape."

"David, to me everything exists only on tape."

"I can't help you, Aesop." Surgenor looked around the metal walls, behind every one of which were the myriad copper skeins of Aesop's nervous system, and he felt a curious emotion. Pity compounded with distaste. He tried to think of something relevant and meaningful

to say, but the words which emerged were trite and utterly incongruous. "You had better forget her."

"Thank you for the advice," Aesop said, and there was a vast, inhuman sadness in his voice. "But I have a perfect memory."

That's tough, Surgenor thought, as he closed the door of his room behind him and hurried in the direction of the mess with his good news. Already, as is the way with human beings, the images of Julie Cornwallis were fading from his mind, to be replaced by pleasurable thoughts about the precious fleeting afternoons of winter on Earth, about football matches and cigar stores and women at supper tables, and about the deep comforts of families drawing together at Christmas. ■

Unified Field Theory

TIM JOSEPH

In the beginning there was Aristotle,
And objects at rest tended to remain at rest,
And objects in motion tended to come to rest,
And soon everything was at rest,
And God saw that it was boring.

Then God created Newton,
And objects at rest tended to remain at rest,
But objects in motion tended to remain in motion,
And energy was conserved and momentum was conserved
and matter was conserved,
And God saw that it was conservative.

Then God created Einstein,
And everything was relative,
And fast things became short,
And straight things became curved,
And the universe was filled with inertial frames,
And God saw that it was relatively general,
but some of it was especially relative.

Then God created Bohr,
And there was the principle,
And the principle was quantum,
And all things were quantified,
But some things were still relative,
And God saw that it was confusing.

Then God was going to create Furgeson,
And Furgeson would have unified,
And he would have fielded a theory,
And all would have been one,
But it was the seventh day,
And God rested,
And objects at rest tend to remain at rest.

THE VISIBLE MAN

Rehabilitation isn't just another word for torture . . . or is it?

GARDNER R. DOZOIS

JOHN SCHOENHERR

George Rowan's only chance of escape came to him like a benediction, sudden and unlooked for, on the road between Newburyport and Boston.

They were on old Route 1, the Newburyport Turnpike, and there was not another car in sight. The fully automated Route 95 guideway was just a few miles west of here, running almost parallel to Route 1, but for reasons of his own the sheriff had preferred to take the old secondary road, even though he had to drive the car himself and couldn't possibly get up to guideway speeds. Perhaps he simply enjoyed manual driving. Perhaps it was some old State regulation, now solidified into tradition, that prohibited the transportation of prisoners on automated roads. Perhaps it was just some more of the expected psychological torture, taking the slowest possible route so that Rowan would have time to build up a greater charge of fear and dreadful anticipation for what awaited him in Boston.

For Rowan, the trip had already become interminable. His memory of the jail in Newburyport, of his crime, of his hasty trial, of his past life—all had become hazy and indistinct. It seemed as if he had been riding forever, on the road, going to Boston for the execution of his sentence. Only that was real and vivid: the slight swaying motion of the car, the seat upholstery sticking uncomfortably to his sweat-soaked back, the ridged rubber mat under his feet. The countryside they drove through was flat and empty, trees, meadows, cultivated fields, little streams, sometimes a boarded-up gas station or a long-abandoned roadside stand. The sky was a flat, washed-out blue, and the sunlight was thick and dusty. Occasionally they would bump over a pothole or a stretch of frost-buckled pavement—the State didn't spend much anymore to keep up the secondary roads. The car's electric engine made no sound at all, and the interior of the car was close and hot with the windows rolled up.

Rowan found himself reluctantly watching the little motions of the steering wheel, apparently turning all by itself, driverless. That made him shiver. He knew intellectually, of course, that he was sitting on the front seat between the sheriff and the deputy, but he couldn't *see* them. He could hear them breathing, and occasionally the deputy's arm would brush against his own, but, for Rowan, they were invisible.

He knew why they were invisible, but that didn't make it any less spooky. When the State's analysis computers had gone down into his mind and found the memories that proved him guilty, they had also, as a matter of course, implanted a very deep and very specific hypnotic injunction: from now on, George Rowan would not be able to see any other

living creature. Apparently the injunction had not included trees and other kinds of vegetation, but it had covered animals and birds and people. He assumed that when he "saw" through invisible people—as he now "saw" the portions of the car that should have been blocked from sight by the sheriff's body—it was because his subconscious mind was extrapolating, creating a logical extension of the view from other visual data in order to comply with the spirit of the injunction. Nothing must be allowed to spoil the illusion. Nor could Rowan break it, although he knew what it was and how it had been created. It was too strong, and planted too deep. He was "blind" in a special and insidious way.

There were a number of apparently sound reasons for doing this to convicted criminals. It made it almost impossible for a prisoner to escape or to resist his captors, for one thing, and the State psychologists also claimed that the resultant sense of supernatural isolation would engender an identity crisis in the prisoner, and so help contribute to his rehabilitation. Totally "blinding" the prisoners would accomplish both objectives in a more logical way. But the State administrators had been growing increasingly perverse over the years, and they chose the cruelest way. How much more terrible a thing this was than total blindness—to make the victim live in a sunlit empty world, haunted by ghosts and voices, pushed and punished by unseen forces, never knowing who was with him or what they were about to do to him. So the State men inflicted this on prisoners because it was cruel and they enjoyed it, just as they would enjoy torturing Rowan in Boston, driving him insane again and again in the name of psychological rehabilitation.

At that moment, past Topsfield but not yet up to the Putnamville Reservoir, their right front tire blew out.

They went into a terrifying spin. The world dissolved into a whirling blur, and bursts of sunlight jabbed Rowan's face like a strobe light as they spun. The car hit the guardrail, spun out into the middle of the road again, spun back to hit the guardrail a second time. In the midst of the roar and the clatter and impact, Rowan had time to think that it would be better for him if he was killed in the crash, and time to realize that in spite of everything he did not want to die. Then the car was spinning out into the road, spinning back again. This time there was no guardrail to catch it. The car went careening off the road, fishtailing and losing momentum as it plowed through the deep soft loam of the shoulder, and dived into a shallow ditch.

The dashboard leaped up and whammed into Rowan, but he managed to catch the blow on his

arms and shoulders; the impact beat him black-and-blue, but did no lasting damage. In the same instant, as he was hitting the dashboard, he saw the windshield above the driver's seat star and shatter, and the invisible deputy was thrown heavily against him. The car recoiled from the impact, slid a foot or two sideways, and canted to the left. Everything was still for a heartbeat, and then the car groaned and settled, canting over even more. The noise of the springs died away.

There was a strangely peaceful silence.

The car was resting head down at a forty-five-degree angle, listing badly to the left but not quite turned all the way over on its side. Rowan took a deep, shaky breath and decided that he was alive. The sheriff might not be. He was still invisible to Rowan, but it was obvious that he had been thrown partially through the windshield. Rowan had ended up leaning against the sheriff's hip, and if his hips were at a level with the steering wheel then the rest of his body had to be protruding through the windshield. And there was blood on the glass. From the feel of it, the deputy seemed to be slumped over with his head almost in Rowan's lap, stirring feebly, stunned but still alive. No conscious cogitation went on in Rowan's mind, but as the deputy pushed against him and tried to sit up, Rowan raised his manacled hands and smashed them down on what he hoped was the deputy's head. The first blow hit something soft, and the deputy began struggling weakly, but the second blow bit bone. The deputy stopped fighting. Rowan struck him again, and he stopped moving at all.

Rowan sat quietly for a second, his breath hissing harshly in his throat, and then patted the deputy with his hands until he touched a jingly metal object. As he lifted it away from the deputy, it became visible for him, and yes, it was a key ring. He used one of the keys to unlock his handcuffs, and spent another few seconds searching the deputy for a gun; he didn't find one, and decided that he couldn't afford to waste any more time. He climbed over the deputy, rolled the side window down, and pulled himself up out of the car.

He jumped down to the ground, lost his footing on the grassy slope, and went to his knees. For a moment, he remained kneeling, blinking in the raw hot sunlight, dirt under his fingers. Everything had happened too fast; only now, this instant with the sun in his face, did it become real for him—he was outside, he was free, he had a chance. Hope and terror exploded inside Rowan. He rose into a crouch, scanning his surroundings with a sudden feral intensity. Then he scrambled up the incline. At the top of the slope he paused only

long enough to make sure no cars were coming before he dashed across the road and slid down into another ditch in an avalanche of dust and scree. A man-high expanse of grass and wildflowers stretched away from the road on this side. It closed over Rowan like the sea.

At first, he ran flat-out, fast as he could go, the high grass whipping around him, wild with fear and exhilaration. He kept running until his breath was gone and he was staggering rather than sprinting, and then a root snagged his foot and the ground reached up to catch him, *smack,* like an outfielder catching a fly ball. He lay spread-eagled, flat on his face against the damp earth, gasping for air while everything seemed slowly to spin, the resin-smelling grass tickling his nose, tiny furtive insects scampering invisibly across his hands. When he could breathe again, he found that some of his panic had also gone. He sat up. He'd been leaving a trail like a goddamned elephant; he'd have to start being a little slier. If he trampled the grass and left a flattened wake behind him, it would be like a giant arrow pointing the way he had gone. He wouldn't last an hour that way before the cops ran him down. He set off at a diagonal to his former path, picking his way with care, forcing himself to be slow. This way, perhaps he had a chance. More than he'd had a while ago, at least.

Rowan reached a stand of scrub woods and pushed his pace up to a fast trot, taking a few more headers as the terrain got rougher. Every time the tree branches moved in the wind all the patterns of light and darkness would flow and reform, and he kept mistaking shadow for ground. Once he dropped four feet down a concealed embankment. He kept up the pace. If he broke an ankle he was finished, but he couldn't afford to slow down either. They'd almost certainly catch him if they fielded a search party anytime soon. But Route 1 was infrequently patroled, that was in his favor, and the Boston people wouldn't miss the sheriff for a while yet. If only he could get even an hour's lead—

After a few minutes, the woods began to die away into a region of small isolated trees and high bramble thickets. Rowan slid down a final bluff and found himself in someone's alfalfa field. His second wind was long gone, and now every breath brought him a stab of pain in his side. He began to work his way around the field, skirting the outermost furrow. He walked slowly and painfully. Sweat had dried uncomfortably on his skin, making him itch, and his clothes were full of burrs and stickers. On the horizon, he could just make out the peaked roof of a farm building, thumbnail-small from here, gray

tile glinting in the sun. A thin column of smoke rose black from a chimney, making a long lazy line across the sky. Rowan was half-way across the field, his shoes filling with loam at every step, when a dog began to bark in the distance.

Rowan walked faster, but the barking became louder and closer. A goddamn watchdog then, definitely coming after him. He faced around, at bay, too beat-out to run for the tree line.

The barking swelled into an angry challenging roar, and then cut off, ominous and abrupt. Impossible to tell which way it was coming in at him, he thought, and at that same instant felt a flash of searing pain as his pants leg was torn away by something invisible. Rowan cursed and kicked out wildly. His foot scored a solid hit on something, and the dog yelped. Rowan kicked out again, missed completely, and had to do a lurching gracestep to recover his balance. Pawprints appeared in the soft loam as the dog danced back out of range. Rowan realized that if he kept near the furrow he'd be able to track the dog's movements in the loam. So when a line of pawprints came rushing directly in toward him like the wake of a torpedo, he judged his distance carefully and then lashed out with all his strength. His foot hit something with the clean, solid *whump* of a dropkicked football. The dog yelped again. It was apparently lifted off its feet by the impact and sent rolling across the top of the furrow—at least, that was how Rowan interpreted the sudden flattening of alfalfa and scattering of loam. Rowan started walking again, with great deliberation. Judging by the sound, the dog continued to trace snarling figure-eights around him at a safe distance, but it did not attack again.

Rowan scrambled up into the scrub brush on the far side of the field and started off again, limping slightly, unwilling to take time to tend to the bite. If only he dared to rest. All his instincts told him to go to ground, find a sheltered spot in the deep woods and hide. But that would never work. They'd fly over the nearby forested areas with infrared heat sensors and spot him at once—there were no animals the size of a man left in the Massachusetts woods, any large trace would unequivocally be the fugitive. No, he would have to go to a town, where his heat-trace would be lost among those of other people. But the towns were the very place where he'd be the most helpless, and the most exposed.

He crossed another cultivated field—seeing only a tractor moving far away across acres of soughing green-and-yellow grain—and then the ground began to turn porous and swampy, water oozing up to fill his footprints as soon as he had made them. At last he was faced with an actual stretch of marsh-

land, miles of reeds and cat-o'-nine-tails interlaced with gleaming fingers of water. He was forced to turn more to the east to skirt it. Walking by the edge of the marsh, he could hear the whining of millions of mosquitoes, but could see none of them, even when they bit him. Occasionally there would be a splash and a little gout of water alongside him as he passed—frogs hopping off the bank to get out of his way, he assumed. Other unseen things rustled through the reeds around him. On the larger ponds, he could see the surface of the water wrinkle into a crumped leaf pattern as waterbirds landed or took off, but he couldn't see the birds themselves. The air was full of invisible wings. Rowan found all of this so uncanny that he detoured, shivering, far enough to the north to get away from the marsh entirely. The ground began to rise again. There were cuts in the sides of hillocks here, and planed-off places, evidence of recent road-building. He pushed through a weed-choked scrub woodlot, and found himself on a bluff overlooking one of those strange suburban housing developments that seem to sprout up out of nowhere in the rural areas of Massachusetts, unconnected with anything and with no viable reason for existence.

Rowan's throat went dry. This would be the first major hurdle. He descended the bluff.

At least there didn't seem to be anybody around, Rowan thought, and then grimaced at his own fatigue-engendered stupidity. There could be a crowd within ten feet of him, or a posse armed to the teeth, and he'd never know it until the first shot went home. He started walking slowly along a sidewalk, heading for the crossroads he could see on the other side of the housing development. This seemed to be a fairly new complex. The lawns were still smears of ugly red clay, surrounded by hopeful little string fences that were somehow supposed to keep birds from eating the newly-planted grass seeds, and there had not yet been time for the basements to fill up with marshwater or the paint to peel off in the bitter sea wind. Maybe most people had gone to work, leaving only a few housepersons here and there, and maybe they would stay inside. His foot struck something.

"Hey!" said a voice, at the level of his elbow.

Rowan froze.

"Hey, mister," the voice said, reproachfully, "you knocked over all my soldiers."

A child. Rowan forced himself to think. "I'm sorry, son," he said.

"The whole army!"

"I didn't see you," Rowan said, truthfully, "I'm sorry I messed up your army."

Suspicious silence from the boy.

"I wasn't thinking about where I was going," Rowan said. That got a *huhn* sound out of the boy, who

didn't sound entirely mollified. The boy must have stood up then, as some of the toy soldiers he'd been touching became visible for Rowan, varicolored plastic figures lying askew on the sidewalk. Rowan hesitated, and then asked, "Which one of those roads leads to Hamilton?"

"That one."

Wonderful. "The paved one?" Rowan asked cannily, and when the boy didn't answer he pointed and said, "That one there?"

"Uh-huh," the boy said. The tone of puzzled suspicion was back in the child's voice. There was something odd about this grown-up. The boy didn't respond when Rowan thanked him, but from the little scraping noises Rowan heard he guessed that the boy had sat down and begun to move his soldiers about again. The child had lost interest in Rowan. There was something odd about all grown-ups, and Rowan wasn't unusual enough to provoke more than a mild passing wonderment.

Rowan started off again. "You stepped on my fort!" the child wailed instantly. Ignoring him, Rowan kept walking. He maintained a brisk pace, keeping close to the curb and hoping that anyone coming up the sidewalk in the opposite direction would have room to pass him without contact. In this fashion, he managed to make it through the development without further incident, and onto the road that led, hopefully, to Hamilton. Surely a search party would be out after him by now; if he didn't find a town to lose himself in, he'd be finished. There were no sidewalks here, and no traffic on this one-lane back road, and if he kept to the center of it the chances of colliding with someone out for a stroll were remote. He walked as fast as he could without actually breaking into a suspicion-provoking run.

When the housing development was hidden by a curve, he increased his pace to a fast trot. He could be jogging, couldn't he? And besides, there was no help for it: his time was running out. The road began to climb, winding among small rolling hillocks, and the forest closed down on either side. Once a dog came down from some house set back in the trees, and yapped after him for a few hundred yards, but didn't attack. About ten minutes after the dog gave up the chase, he came upon another house, this one set back from the road and climbing partway up a low hillside. There was a bicycle lying next to the road on the wide front lawn. Someone might be watching from the house, but Rowan decided that he'd have to take that chance. He walked casually over to the bicycle, set it upright in the road, mounted it, and rode unhurriedly away until the house was out of sight. Then he began to pump.

The bicycle was too small for

him, but not small enough to make the proposition impossible. It wobbled some, but he sent it whizzing along as fast as he was physically able to peddle. It rattled and creaked in protest, but it held together. Somehow he also managed to keep the thing upright and stay on top of it. The bicycle wasn't a racer, but Rowan was a powerful man, and more important, a desperate man, and he got it up to a pretty respectable clip. He could cover twice the ground now that he could on foot, and he felt a thrill of real hope. Rowan peddled through the hills for a while, and then the country began to level out. Here the road intersected a somewhat larger secondary road, two lanes instead of one.

Guessing at the direction of Hamilton, he turned onto the larger road. It was flat and straight, and Rowan made even better time. Dust boiled up from the pavement as he passed, and hung in the still air behind him in long wavering lines. Thank God for the guideways, Rowan thought—traffic was light even on the larger manual roads. He only encountered one car, going in the opposite direction, its steering wheel apparently turning by itself. He had to caution himself not to stare at it as it passed. Then he was alone on the road again, with only the squeak and rattle of the bicycle for company. After a while, houses began to appear more frequently by the side of the road, and there were cross-streets every so often, with overhead traffic lights at the intersections. He was barreling across one such intersection at full tilt when he crashed into something unseen but very solid.

The impact hurled Rowan from the bicycle head over heels. He hit the street, rolled, skidded along on his side and jarred to a stop against the curb. By the time he understood what was happening, he was resting on his elbows in the road and staring up at the sky, dazed and shaken. He was badly scraped along his arms and legs, and bits of gravel had been embedded under his skin by the force of the fall. Rubber-legged, he got up. There was a groan of pain from the unseen something he'd hit, and then it said a pithy word. A man, then. Some pedestrian had been crossing the road and he'd smashed into him. The bicycle was shoved clatteringly aside, and Rowan assumed that the man was getting to his feet.

"What are you, blind?" the man raged. "You sorry son-of-a-bitch!"

"I'm sorry, but you stepped right out—"

"You had plenty of room! You had miles of room!" The voice wavered slightly as it climbed in register: an elderly man, then. "What's-t'matter, you ain't got eyes in your head? You could've turned! I swear I'll sue you, you hear that? Knock me down, almost break my back—"

"Don't frazzle off, old friend," Rowan said nastily. Soft-talk wouldn't work. He had to be truculent and menacing or he'd be arguing with this guy for hours. Play it like a young tough, a weep maybe. "It was just an accident, right? You scan that? Only an accident. So don't give me the rest of this fargo, because I don't want to hear it."

"I've got a mind to have you run in, you son-of-a-bitch."

"Shove it. You know, you could get hurt a lot worse, jobbie."

There had been an edge in Rowan's voice—the man sputtered, but remained silent. Rowan swaggered over to the bicycle, feeling self-conscious but playing it up. The bicycle didn't seem to be significantly damaged, although the frame was a little bent and the handlebars had been knocked out of alignment. He twisted them back into true, climbed onto the bicycle and shoved off. When Rowan was a safe distance away, the man shouted after him, "Goddamn idiot! I hope somebody cuts your balls off!"

Wobbling more than before, Rowan peddled down the road. He had to think of something else soon. He was entering the outskirts of a town, and the chances of hitting another invisible pedestrian increased with every revolution of the bicycle wheels. And now he thought he could hear the thin keening of sirens high in the sky behind him, an eerie sound that might have been made by demons of the upper air. They were coming after him, and he was much too conspicuous bicycling down this traffic-free road. Just as he was about to ditch the bicycle, he topped a rise and came upon a truck waiting on a red light at an intersection, one of the moderate-sized vans still used for hauling freight between small cities not serviced by guideways. Rowan's eyes narrowed in instant calculation. Carefully, he coasted to a stop squarely behind the truck, where he would be out of range of the driver's mirror. He dismounted, picked up the bicycle and threw it into a tangle of high weeds and bushes by the roadside. Then, as the light changed and the truck started to accelerate, he leaped up and grabbed the edge of the latched tailgate.

The truck's van was protected only by a hanging tarpaulin. Rowan brushed it back, pulled himself over the tailgate and tumbled inside. He landed on something with hard edges, squirmed aside, and came to rest on the vibrating metal floor. They continued to gather speed, gears growling—evidently the driver had not seen him come aboard. Rowan sank back on his haunches, and then stretched out as well as he could among the sealed boxes and crates, pillowing his head with his arms. He had never been so tired. The hard metal floor

felt as soft as thistledown. He felt himself sinking into it, sinking down luxuriantly. Grimly, he forced his eyelids wide again and made a great effort to stay awake. He had been given an opportunity to think things through without the pressure of split-second decisions; he should be trying to formulate long-range plans, plot out a plan of action instead of just running aimlessly away. But his brain had turned to ash, and he could not think. Besides, where was there to go? Who was there who could help him? His friends were all back in Newburyport, and that old life seemed even more distanced and inconsequential than it had this morning, his old acquaintances only hazy figures from an almost-forgotten dream. Dream-men, phantasms, they could not help him. The floor was spinning, slowly and restfully. He knew it was a terrible mistake to doze, but he could no longer fight it. He fell asleep.

He was awakened by a harsh, frightening sound: the rattle and clank of the tailgate being unlatched.

Rowan pulled himself up out of evil, smothering dreams. When his eyes unblurred, he saw only a rectangular green thing with glowing edges, and it took him a moment to realize that it was the tarpaulin, with light leaking in around the sides. At first, he didn't realize that the truck had stopped. Then he heard the tailgate *thump* as it was swung down. He sat up, terrified and floundering, still only half-understanding where he was. The tarpaulin was yanked aside. Blinking around the sudden influx of light, Rowan was astonished to see that no one was there. Then he remembered, in an intense, sickening flash, and had to adjust himself to it all over again, as he would have to every morning for whatever remained of his life.

"You floorsucker!" a voice said.

Before Rowan could move, he was seized by hard invisible hands, hauled from the truck—getting a brief dizzy glimpse of concrete, a high metal ceiling, arc lights—and set on his feet. The hands released him.

"I—" Rowan started to say. His vision exploded into shooting white sparks, pain lanced through his head. He reeled back against the truck and almost fell. His mouth filled with blood.

"Whatta y'think y'doin?" the voice said, harsh with rage. "You scupping thief!"

Pain had jolted Rowan fully awake. Instantly, he lashed out with his fist, aiming at the spot from which the voice had seemed to emanate. He missed completely, his arm scything the air, and took a hard punch to the stomach from his unseen adversary. It knocked the wind out of him and drove him back against the edge of the lowered tailgate. It was hopeless, he

realized through a wave of nausea. He couldn't win.

The next blow laid Rowan's cheek open and threw him sideways to the concrete floor. He went along with the fall, augmented it, and rolled over twice very quickly. Then he scrambled to his feet and ran.

Someone shouted hoarsely behind him. Rowan kept running, heading for the far side of what was apparently an underground garage. Halfway across, he slammed into something solid but yielding; another invisible person. There was a gasp of surprise and pain, and the clatter of dropped tools. Probably he'd bowled the man over. Rowan himself staggered and nearly fell, but recovered his balance and kept on. He was sprinting with his head down now, dodging and weaving like a broken-field runner. More shouts behind him. Invisible hands clutched at him for a moment, but he broke free. A door seemed to spring up in front of him. He clawed it open and sprang through.

He found himself in a long, fluorescent corridor, the cold white light coming evenly from ceiling, walls and floor. He sprinted away to the left, followed the corridor to a fork, picked a branch at random and kept running. Then another fork, and another corridor. He found a door marked *Employees Only,* went down a small service stairway, through another network of corridors, and down another stairway to the bottom.

The corridor he emerged into this time was dingier than the others, faded tile and green-painted stone, lit by hanging overhead bulbs. There was a smell of damp in the air, and the stone walls sweated like toads. Rowan paused to rest, gasping and leaning against the doorframe. When his breathing evened enough to let him hear again, he listened for sounds of pursuit. Nothing. He'd lost them. And this was a basement corridor, few people would be traveling it. And now, he knew where he was. Even in flight, he had had time to recognize the trademark insignia embossed into the walls of the upper corridors—he was in one of the big shopping plaza complexes near Danvers. But how was he going to get out of here? There were sure to be thousands of people about in the complex; as soon as he came up out of the deserted basement corridors he would inevitably run into some of them. The faded denim pants and blue work-shirt he wore were not damning in themselves, but would certainly be a giveaway to anyone actively searching for an escaped prisoner. Somehow, he had to get a change of clothes.

Rowan started walking again, cautiously threading his way through a warren of basement corridors that seemed endless. Occasionally there were doors set in ei-

ther wall, always locked and bolted. Storerooms, probably. From behind a few of the locked doors came the solemn, deep-throated chuffing and pounding of massive machinery, or, more rarely, a vibrant unwavering hum. Eventually, he passed into what seemed to be an older section of the complex. Here huge ceramic-covered pipes ran along the ceiling close overhead, the floor was rutted, and there were patches of mold on the walls. Some of the overhead lights were broken, and Rowan walked on through semi-darkness until he came to a door marked *Maintenance* at the junction of two shabby corridors. From behind this door came an unmistakable sound: someone snoring.

Quivering with tension, Rowan put his ear to the thin plastic door-panel. The only sound he could hear was the rhythmical snoring. He'd have to chance it. Carefully, he tried the door. It wasn't locked. He inched it open until a hinge gave a loud rusty squawk, then he pulled the door wide and stepped briskly into the room.

It was a small chamber with faded opalescent walls, smelling of sweat and old clothes and *bozuk*. Two walls were covered with dials, meters, readouts and tell-me-twices. A dusty computer terminal and a slave board stood in that corner. Most of the room was taken up by a dilapidated sink-cooker combination and a scarred folding table heaped with filthy biodegradable plates that had been re-used instead of catalyzed. In another corner was a much-patched waterbed. Flies drummed noisily against the walls, seeking a way out.

As Rowan entered the room, the snoring cut abruptly off. A man-shaped dent in the waterbed began to work itself back to level. Someone was getting up. "What?" said a cracked, quavery voice: another old man. "Whatta'y'want? Who—" The dent disappeared; the man must be on his feet now. "Inspection, jobbie," Rowan said slyly, "special orders from the manager," using the custodian's resultant hesitation to get a few steps nearer. Then he leaped.

The custodian screamed. Rowan ended up with a double-handful of cloth—a shirt?—which immediately tore away in his grasp, lunged again and felt his hand close around a bony wrist. He twisted it. The custodian screamed again. Rowan felt the custodian's free hand pound against the side of his head, and then they were wrestling each other in a drunken circle across the floor. The table went over with a great smash and clatter of plates. The custodian was still screaming. What a racket they were making! "Shut up, you!" Rowan shouted inanely, then managed to get a hand around the custodian's invisible throat. Ignoring a rain of wild windmill blows, Rowan throttled him into submission.

When the custodian went limp, Rowan let him slide to the floor. Suddenly everything was amazingly quiet. Swaying and gasping for breath, Rowan was washed over by a prickly wave of shame. He was pretty good at beating up old men, wasn't he? Suppose he'd killed the old guy? Apprehensively, Rowan crouched and felt about until he located the custodian, touching long invisible hair the texture of matted straw, and a scraggly beard—some ancient hippie given a makework job by the complex then, a *bozuk* addict probably. Rowan felt for a heartbeat. It was there—papery and labored, but there.

Relieved, Rowan began to search the custodian. Nothing—he was wearing some kind of frilly smock or dress without pockets. But on a night-stand near the waterbed Rowan found an odd leather object, and realized after a moment's thought that it must be wallet. Inside the old wallet were several unusual photographs, an identification card—with an embossed picture of the old man on it, unfortunately—a credit strip, and a nearly exhausted monthly commuter ticket. Rowan examined the credit strip and bit his lip in frustration. The custodian didn't have much of a debit margin, not nearly as much as Rowan had hoped for. Not enough to buy a ticket out of the country or even out of the state, not enough to rent a car, or get an identity-scramble or an apartment to hole up in, so that was the end of those particular fantasies. And there wasn't enough left of the commuter ticket even to get him to Boston.

The custodian began to moan. Rowan paced over, located him again, and lifted his fist to clip him. But he couldn't bring himself to do it—the old man was so frail, it might kill him. Swearing at his squeamishness, Rowan dragged the feebly-struggling custodian to a closet, muscled him into it, and braced a chair against the door to keep it closed. "Hey!" the custodian shouted, and began to rattle the doorknob furiously. "Shut up," Rowan growled in self-conscious toughness, "or I'll come in there and tear your head off." The custodian shut up.

Rowan returned to the computer terminal. He'd have to do the best he could with what he had. He thought for a minute, then activated the terminal and dialed for the catalog of one of the big stores overhead. He computed sums in his head. Just enough. He inserted the coded credit slip into the slot and carefully punched out an order on the keyboard. The computer winked an acknowledgment light at him, and printed *Five Minutes* across the readout in green phosphorescent letters.

Sighing, Rowan leaned back in the chair to wait. Now that the immediate pressure was off, he realized how exhausted he was, how sore and battered and torn. His

split lip ached fiercely, as did his lacerated cheek and his scraped arms. But most of all, he was *tired.* The room seemed to blur in and out of existence, and Rowan pulled up out of the nod just in time to keep his head from cracking against the terminal board. He'd almost fallen asleep. Stiffly, he got up. He was still rubber-legged, and very weak. Hunger was part of it. He literally could not remember the last time he'd eaten—sometime during his stay at the Newburyport jail, he supposed, but his memories of that ordeal were murky and confused. It could have been days. And he was intolerably thirsty.

He rummaged through the cubicle in search of food, but found nothing except a bar of VitaGel and a half-empty bottle of Joy. Grimacing with distaste, he ate the gluey bar, and then cautiously tried a sip of Joy. The euphoric effect hit him instantly, making him lightheaded and giddy. Reluctantly, he put the bottle aside—he couldn't afford to get frazzled. There didn't seem to be any cups at all in the place, but he polished a small plate as well as he could with his sleeve and used it to get a drink of rusty water from the tap. The Joy was making his head buzz. He had an odd feeling of unreality and déjà vu, and a sudden strong intuition that the old custodian was about to speak. Just at that moment, the custodian said "Hey, man, you're never going to get away with this, you know that?" and Rowan subvocalized the last few words along with him, the feeling of déjà vu returning ten-fold. "Shut up, jobbie," Rowan growled, still with the feeling that he was reading something from a prepared script, "I really shouldn't be keeping you alive at all, scan?" The old man quieted again, but Rowan's head remained full of odd echoes, as if everything were doubled or tripled, crowding the room with ghosts and reflections. He never should have touched that goddamned Joy.

The terminal flashed its mauve warning light while Rowan was washing his face in the sink basin. His order thumped down the pneumatic shute into the hopper. Rowan quickly dried his face with his shirt. The water had cleared his head a little, and he looked much more presentable with the dirt and dried blood washed away. Feeling almost jaunty, he stripped off the rest of his clothes and padded over to pick up the package.

The package contained a nondescript shirt, some cloth pants, an overcoat, a hat, a pair of dark glasses, and a cane. If he must cope with being "blind," then let him be a "blind man." One of the hard-core blind, too low-caste to qualify for a TVSS. He would attract much less suspicion that way—the pose would explain why he was continually bumping into people, and he hoped that the Purloined Letter syndrome would also work

to his advantage. At the least, he would be more difficult to spot.

Rowan dressed hurriedly and left the room. He wouldn't have much time to get clear of the complex before an alarm was raised. The chair he'd braced under the doorknob was only made of hard plastic, and already, as Rowan hesitated in the corridor, he could hear the custodian attempting to break out of the closet. He really should have killed the old man—later he would probably have cause to regret that he had not. He set out through the warren of basement corridors.

He'd decided that it would be best to try to retrace his steps, but within a few moments he was hopelessly lost. A series of locked doors and blocked-off corridors gradually herded him in an entirely different direction, and he wandered through the old stone maze for what seemed like hours. Finally, just as he was beginning to despair, he located an unlocked service stairway.

At the top of the stairway, he stepped through a door and found himself in another of the fluorescent upper corridors. He struck out along it, remembering to tap the floor in front of him with his cane, and bumped into someone almost immediately.

"Oh, excuse me!" a voice said; a woman this time. "I guess I wasn't looking where I was going."

"That's perfectly all right, missy," Rowan said politely, and started to tap his way along again. There was no interference, no alarm.

Goddamn, it was going to work after all, wasn't it!

A few yards further on, he found one of the main stairways, and followed it up. He was suddenly claustrophobic, the whole subterranean complex pressing down on him with miles of corridors and stairs, steel, concrete, rock, plastic, dead black earth. God, to get *out*—

Sunlight struck him in the face.

It was still the same day, Rowan realized bemusedly, staring at the sky. Just a little while ago he had been on his way to Boston for the execution of his sentence. That had been years ago, it seemed. Decades ago. A lifetime. But the position of the sun showed that it had been barely four hours. Time enough, Rowan thought. Surely an active hunt for him was underway by now.

Rowan had come out onto a landscaped mall, pyramidal buildings rearing high all around, windows flashing like hydra eyes in the sun. Hundreds of people were moving invisibly all around him; he could sense their presence as a nearly subliminal susurrus composed primarily of footsteps and voices. This type of shopping complex was potentially obsolete—the existence of house-to-store pneumatic networks should have killed them as dead as the dinosaurs. But this was an underpopulated region,

where most of the homes still didn't have computer terminals; so far, downtown Boston was the closest area to have been completely converted to the system. It took time for advanced technology to disseminate across a society. And herd instinct was also a factor. With the commercial heart eaten out of the smaller towns, people gathered at the shopping plazas as earlier peoples had gathered at wells or watering-holes or drive-in restaurants, and for the same reasons: to gossip, to court, to meet friends, or just to have someplace to go at night. On a sunny day like this, there could easily be ten thousand people circulating through the complex, and somehow Rowan would have to get by them all.

He launched himself away from the shelter of a building, like a swimmer kicking off for a race, was jostled repeatedly, and realized that he was trying to buck a stream of pedestrian traffic going in the opposite direction. Obediently, Rowan turned around and let the pressure of that stream sweep him along, trusting that people would make allowances for a blind man and not crowd him too closely. The stream hurried him through the mall and into a covered walkway between buildings. Here, suddenly confined, the murmur of crowd-noises swelled into a roar. Clacking footsteps echoed and re-echoed from the low ceiling, voices reverberated hollowly—all sound became fuzzy and directionless, as though he were in a cave under the sea. Again the air seemed full of invisible wings. He could almost feel them beating around his ears, hemming him in, wrapping him in gossamer.

Suddenly dizzy, Rowan sat down on a bench. He found that his heart was beating fast with irrational terror. His nerves were giving under the strain, he told himself as he fought down another attack of claustrophobia. He couldn't take much more. Slowly, he calmed himself. At least his disguise seemed to be working.

Someone touched his arm. "You're an escaped convict, aren't you?"

Rowan gasped. He would have jumped up and bolted instantly, but now the hand was on his wrist, holding him down. He half-turned, shifting his grip on the cane so that he could use it as a club.

"Hold it!" the unseen someone said in a low, urgent voice. "Don't run. Calm down, son—I'm on your side."

Rowan hesitated. "This is some kind of mistake—"

"No it's not," the other man said dryly. "You're pretending to be blind, aren't you? That's a good one, it hasn't been used much the last few years. You might get away with it. But don't just tap right in front of your feet, the way you've been doing. That's a dead giveaway. Keep your cane swinging

steadily from side to side as you tap. Remember, you're supposed to be feeling your way along with it, like a bug does with his antennas, right? And don't walk so fast. Be a little more uncertain about it, son, *listen* more, as if you're trying for auditory clues. And for God's sake, stop staring at things. And tracking them! It's obvious you can see through those damn glasses. You won't last an hour that way."

Rowan opened his mouth, closed it again. "Who are you?" he said.

"It's a real stroke of luck, me being able to spot you," the other man said, ignoring him. "I hoped you'd show up in this area, and I've been cruising around for an hour trying to pick you up. Logical, in a way, prisoners making for a place like this, cops don't seem to think that way though. Luckily for you. Still, we're going to have to jump to get you out of here. But don't you worry—you just listen to me, now, and you'll be all right. I'm on your side, son."

"I wasn't aware that I had a side," Rowan said wearily.

"You do now, son, you do now. Whether you like it or not. The enemy of my enemy, right?" As the man was saying this, Rowan had a sudden vivid mental picture of how he must look: a small, intense man of middle years with a foxy, florid face and hair like wire brush. "Listen, now," the man said, "we haven't got much time. You know Quincy Park in Beverly? Just down the coast a ways from Dane Street Beach?"

Rowan realized, to his own surprise, that he did know Quincy Park. He could mistily visualize it, the trees, the long grassy slope down to the seawall, the rocky beach, the ocean—he must have passed through there at one time, long ago. "Yeah, I know it," he said.

"Well, you just get there before dark. Get there somehow, whatever you do, if you want to keep on living. It's a station on the Underground Railroad, one we haven't used in a long while. They won't be watching it. I'll call up ahead and arrange it, and there'll be a sailboat waiting for you just offshore at Quincy Park. You get on her, they'll take you up the coast, you'll be safe in Canada by morning. Right? But listen—you've got to make the connection the first time. The boat'll only wait until dark, and we won't send it back there two evenings in a row. You understand? But if you make it to the boat, why, you'll be all right then. You'll be fine."

"I—"

"No, listen now, boy, I mean *really* OK. We'll get you down to Bolivia. The insurrectionists have got equipment at La Paz as good as anything they've got in Boston. They'll break the injunction and you'll be normal again. They've done it a hundred times—you don't think you're the only political pris-

oner ever to escape, do you? And they've got plenty of use for good men down there. So you just concentrate on getting to Beverly, and you'll be OK. Keep up the blind man act, it's your best bet."

"Wait a minute—why can't you just drive me over there now?"

"Too risky. They'll be checking private cars before long, but they might not stop public transportation. Besides, I've got to lead them away from here before they close the ring on you. Now look—you wait around a minute, then head out of here, east. I'm going to intercept one of the patrol sweeps and tell them that I saw you bicycling west, heading for North Reading or Middleton, maybe. They know you stole a bicycle, but they don't know yet that you ditched it. They'll bite. And that'll give you a better chance to make it out of here. Good luck, son."

"But what if—" Rowan found himself talking to empty air; the man was gone. Rowan sat and puzzled at it for a while, then shrugged. What other choice did he have? He got up and tapped his way through the invisible crowds, surreptitiously following painted arrows to the tubetrain stop, trying to comply with the behavioral pointers his benefactor had given him. He did feel more in character that way, he discovered, and more secure.

While he was waiting for the tubetrain, he again heard the wild keening of sirens in the sky, very loud and terrible, swelling until it seemed they must be directly overhead. Rowan didn't look around. Doggedly, he leaned on his cane and waited. The sound of the sirens faded away into distance, was gone. Rowan realized that his legs were trembling. He leaned more heavily on the cane.

The tubetrain arrived. He let it swallow him, shoved his commuter ticket into the computer, and tapped his way to a seat, hoping he wouldn't pick one that was already occupied. He did, but the occupant immediately muttered an apology and moved to another seat. Deference to the blind. It was wonderful. Rowan sat down.

It was odd to ride in an apparently empty tubetrain, and yet at the same time hear all around you a hundred little noises—rustling papers, coughing, footsteps, voices—that proved you were not alone at all. Rowan kept staring out the window at the bland green countryside, then remembering that he was supposed to be blind and looking self-consciously away. He was thinking about what the man at the shopping plaza had said, replaying his words like a tape, analyzing them, sniffing at every nuance of meaning. Only now, after the fact, was he beginning to believe that there might be some truth to what he had been told—that there really was an Underground Railroad, that there would be a boat waiting for

him, that somewhere he could be given a chance to start a whole new life. He wouldn't quite let himself hope, but he was thawing to it.

The train pulled into Salem.

After Salem, the tubeline swung south and then east again to Marblehead, and then on south to Lynn and Boston. But Beverly was about four miles north of Salem, on the far side of the estuary. Rowan supposed that there was some kind of public transportation between the two towns, but he didn't know what, and couldn't have afforded to utilize it anyway; the commuter-ticket was dead. He was going to have to walk. Maybe it was better that way.

Up Essex Street, fumbling and tapping in the dusty sunlight.

Everything went well for perhaps a mile. Then Rowan discovered, to his dismay, that practically the entire eastern half of town had been razed since the last time he'd been through, and was being made over into a vast industrial complex of some sort. On this side of Essex Street, there were still houses and trees, but on the far side, across a flat expanse of asphalt, he was confronted with a chaotic expanse of factories, trainyards, excavations, construction sites and storage areas. Some of the factories were already in operation, others were still going up. The whole region was crisscrossed with deep gullies and pits, and some areas seemed to have been terraced and stairstepped in a manner reminiscent of strip-mining. Construction was taking place on many different levels among the terraces, and a gray haze of smoke hung over everything. East, toward the ocean, a herd of snaky black machines were busily eating the last of a row of old wooden houses.

He had hoped to keep to the side streets, but it seemed that there weren't any side streets here anymore. Unless he circled back to the west, he'd have to keep on following the major thoroughfare north, and that was more risky than he liked.

Rowan decided that he'd have to take the chance of following Essex Street. He had just started to tap his way forward again when woodpulp geysered from a tree alongside him, leaving a ragged new hole in the bark.

Sound slapped his ears a heartbeat later, but by then he was already moving. By the time he consciously realized that someone was shooting at him, he had covered half the distance to the nearest cluster of factory buildings, running faster than he had ever run in his life, dodging and swerving like a madman. Suddenly there was a railing in front of him, with a drop of unknown depth beyond it. He vaulted up and over it without breaking stride. A bullet made the railing ring like a gong a second after he had cleared it.

He dropped about ten feet down

onto hard pavement, took *ukemi* as well as he could, and was up and dodging instantly in spite of a painfully wrenched ankle. As he ran, he was acutely aware of how hot it was under the glaring sun. The only thought in his head was an incongruous wish for a glass of water. Another shot splintered concrete at his heels, and then he was slamming through a door and into a building. It was some kind of huge assembly plant with a cavernous ceiling, full of cold echoes and bitter blue lights. He bullied his way through it, followed by a spreading wave of alarm as he collided with people and knocked work-benches over, staggering, falling down and scrambling up again. As he dodged out a door on the far side of the plant, he heard another gunshot behind him. Then he was tearing through a narrow alleyway between factories. There were rainbow puddles of oil and spilled chemicals on the ground here, and he splashed through them deliberately, hoping that the bitter reek of them would throw his pursuers off if they were tracking him by scent. Someone shouted excitedly at his heels. He ducked into another factory building.

It became phantasmagoria, a nightmare of pursuit—Rowan running endlessly through vast rooms full of shapes and stinks and lights and alien noises, while invisible things snatched at him and tried to pull him down. Everything was fragmentary and disjointed now for Rowan, as though he existed only in discontinuous slices of time. In one such slice, he was hitching a ride on a flat-car that was rumbling through a trainyard between varicolored mountains of chemical waste, listening to sirens and shouts behind him and wondering when he should jump off and run. In another, he was dodging through a multi-leveled forest of oddly-jointed pipes, like a child swarming through a jungle gym. Another, and he was climbing slowly and tenaciously up a cyclone fence. Another, and he was running through a vacant lot, a construction site that had been temporarily abandoned and which had been grown over everywhere by man-high expanses of scrub grass and wild wheat.

Rowan tripped over a discarded tool, fell flat on his face, stayed down. That saved him. A scythe of heat swept across the field at hip level, and suddenly all the grass was burning. This time, they were using lasers. He rolled frantically through the blazing grass in an instinctive attempt to put out the little fires that were starting on his clothes and in his hair, and accidently tumbled down into a steep, clay-sided gulley. There was a sluggish, foot-deep trickle of muddy water at the bottom of the gulley, and he crawled through it on his belly while everything burned above him, choking, blinded by smoke and baked by heat that blis-

tered his back, an inchworm on a griddle in Hell.

Then he was kneeling in a tree-shaded backyard while someone washed his face with a wet, scented towel. He retched helplessly, and firm hands held his head. He had something very important to say, some vitally important thing that he had almost remembered, but when he tried to speak all he could coax from his cracked lips and swollen tongue was an ugly jangling croak. "Shut up, goddamn you," said an anxious voice. A woman's voice. He rested in her arms, and stared up at her in awe. She was radiantly beautiful, as cool and clear as the water she used to sponge him, and she smiled like the sun as she wiped the blood and slime and singed hair from his face. He woke up enough then to realize that he had been slipping in and out of delirium, that he really couldn't see her at all. She was invisible. That seemed very sad and unreasonable. He discussed it with her while she bathed his face, carrying out a long, intricate conversation with her, not even trying to use his voice this time, it was such a poor instrument for communication, and his didn't work anyway. Then she was forcing something into his mouth—a capsule—and holding water to his lips.

Drinking was so painful that it shocked him almost fully awake, and then the antifever capsule hit his system, and that helped too. He realized that she was trying to wrestle him into something. A caftan. "What are you doing?" he asked, quite clearly and reasonably. "Keep quiet!" she snarled. "Raise your arms a little." Dutifully, he helped her get the caftan onto him. The world faded for a moment, and when it came back she was wrapping a scarf around his head. "Cover the singed hair, anyway," she said. "I'd shave your head if I had time. Goddamn you, don't go to sleep! You've got to get out of here, right now."

With an effort, Rowan pulled himself to clarity. He sat up and took his head in his hands. "Come on, come on," the woman was saying nervously, "get up." Her hands took him under the arms and tugged, he scrambled and flailed, pushing with legs that didn't want to work. There was a moment of extraordinary nausea and pain, and then he was on his feet, trembling, half-supported by the woman. "Just stay on your feet now," she said. "You'll be OK. That's right." She took her hands away, and somehow he managed to stay upright, swaying, feeling as if his bones had melted. By this time, Rowan had figured out what was happening, and he clumsily started to thank the woman for helping him, but she cut him off irritably. "Just get out of here, you goddamned fool. I can't do anything more for you. Done more than I should already, I got a family to think of. You just

go on and get out of here now. Road's out that way"—not knowing that he couldn't see which way she was pointing—"don't guess you'd want to go back out over the fence the way you came in, too suspicious." She hesitated, as though afraid to wish him well. "Go on, now," she said at last, and he could almost imagine her making shooing motions at him. Her voice was unsteady. "Please go. I have to think of my family. I can't let them catch you here." He sensed then that she had gone abruptly away. A moment later the back door of the house opened and closed. He wondered if she was still watching him through the glass half of the door. Somehow he hoped that she was.

Rowan made his way around to the front of the house, and discovered that he was on Bridge Street, a mile or more from the factory area, although he had no clear recollection of how he had gotten there. That made it a fairly straightforward problem. He had to follow Bridge Street north another mile, cross the bridge over the estuary, and he would be there. He could hardly feel his body anymore, but that was probably a blessing. It allowed him to sit somewhere far removed from pain and drive his body like a car, coax it along like a beaten-up old heap being driven to a second-hand dealer's lot, the owner swearing bitterly all the way and hoping he can get the thing there before it falls apart. He set out for Beverly.

The world began to turn to mush again as he walked. After a few blocks he started to hallucinate, seeing brief vivid flashes of things that couldn't be there, having long talks with people who didn't exist. He would come back to himself as from a great distance, and find that he was talking to himself in a very loud voice and swinging his arms wildly, or else making hoarse grunting noises, *huhn, huhn,* like an exhausted bear harried closely by hounds. He no longer cared if he attracted attention or even if he bumped into people. He was no longer worried about pursuit; in fact, he had forgotten that anybody was after him. He only knew that he had to get to Beverly. Reaching that goal had become an end in itself; he didn't remember what he was supposed to do when he got there, and he didn't care. All his will was taken up by the task of keeping his body clumping leadenly along, while the world flowed by like porridge.

He was on a bridge, suspended between sea and sky.

Out there to the east was Great Misery Island, then Bakers Island, and then nothing but water, an endless fan of icy water spreading on and out forever, turning into Ocean. There was freedom. To sail out and away forever toward the rising sun, with no restrictions, no boundaries, just infinite space and

Rowan skimming the glassy white tops of the waves.

There was a gusty wet wind coming in from the sea. For what seemed like a very long time it hit Rowan across the face, back and forth, back and forth, as methodical and unpitying as a manager bent on reviving a heavyweight with a wet towel in the tenth round of a losing fight, until Rowan's head finally began to clear. He was slumped against the railing of the bridge, cold metal biting into his armpits. He had hooked his arms over the top rail, and that had kept him from actually falling down, but he had no idea how long he had been hanging there in a daze, staring out into Massachusetts Bay. Sailboats and trawlers were moving back and forth in the deep channel, and the sight of them jarringly reminded him why he had to get to Beverly.

Then he heard sirens in the sky behind him.

Rowan started walking again. He had no reserves left—neither panic nor the imminence of death could prod him into running. He was physically unable to run, no matter what the provocation. So he walked away from his pursuers, trudging slowly across the rest of the bridge and up the hill on the other side. He was in Beverly now, perhaps a quarter-mile from his goal. The sirens were a thin, irritating thread of sound, just on the edge of hearing. They didn't seem to be coming any closer. Perhaps the police were holding a search pattern over Salem.

If only they would stay away for ten more minutes.

Rowan forced himself to walk faster. But the extra effort involved began to jar him away from reality again. He fell into a walking dream of Bolivia, the rugged, sun-bronzed men welcoming him into the ranks of the insurrectionists, the trip to their remote mountain fortresses, the women waiting to welcome him, the important work waiting to be done. A new life. To be free of fear—for the first time in how long? Had he ever been free of fear? Had there ever been a day when someone wasn't spying on him, prying and prodding and pushing him, wrapping him in gossamer that was as strong as iron, controlling him like a puppet? A spark of anger touched him then, and he blazed up like old dead wood. Let the insurrectionists give him a gun—that was all he'd ask for, that was all he wanted.

His anger saved him. He'd been staggering down Rantoulle Street in a somnambulistic daze, and had nearly missed his turn. But rage shook him momentarily awake. He turned onto Edwards Street, past the school. He could hear children playing in the schoolyard, their voices rising and falling through the mellow afternoon air like the shrill calling of birds, but he could not see them as he passed—to his

eyes, only leaves and paper-scraps moved across the asphalt with the wind, and he also moved on with it, alone.

The sirens were getting louder. They were coming after him.

But then he turned a final corner, and the sea spread out below him, glinting and silver and vast, opening the world to the horizon. This was Quincy Park. As he stood on the road above, his eyes followed the long slope down to the seawall, then beyond the beach to the ocean, and to the slim white sailboat that waited there, like a sign, like a dove on the water, like the fulfillment of all the dreams he'd ever known.

Rowan started down the slope toward the ocean, his feet slipping on the grass, breaking at last into a ponderous trot. He was almost there. Hope opened like a wound inside him, molten and amazing.

Something slammed into his ribcage like a white-hot sword, sending him staggering back, knocking the breath and the hope out of him. For a second, the incredible shock of the impact dissolved all illusions, and he remembered, and knew that again he had failed to escape. *Someday!* he shouted in a great silent puff of pain and rage and sudden terrible knowledge. *Someday!*

Then another blow took him over the heart and drove him into darkness.

* * *

The fat man worked the action of the tranquilizer rifle and ejected a gleaming metal dart. "My God!" he breathed, reverentially.

Up the slope, the technicians were already reprogramming the mobile computers for the next run-through, using the stero plotting tanks to set up a paradigm describing all the possible sequences and combinations of sequences that might apply, an exercise in four-dimensional topography and systems-flow. Of course, the computers did all the real work: controlling the sequencing, selecting among tables of alternatives as the real-world situation altered and reprogramming themselves on the fly, coordinating a thousand physical details such as the locking of doors and the blocking of certain corridors that kept the human subject restricted to a manageable spatial network of routes and choices, directing the human "beaters" who helped keep the subject "in the chute," triggering previously implanted fantasy fugue sequences such as the car crash and timing them so that they melded smoothly with real-world action. And much else besides. Nevertheless, the human technicians considered themselves to be overworked, and all made a point of looking harried and rather ostentatiously tired.

A small, foxy-faced man appeared at the fat man's elbow. "Very nice," he said briskly, rub-

bing his hands. "As good a show as I promised you, Senator, I think you'll agree with that. And of course," he added piously, "so valuable therapeutically." He smiled. "Always so many possibilities! Will he get to Hamilton, or end up in Danvers? Will he kill the old man or not? Will he find the car or let me steer him to the tube? An enormous but finite number of choices, aesthetically it's quite elegant. I'm always reminded of the medieval theologies. Free will operating within a framework of predetermination. Of course," he said, smiling ingratiatingly at the fat man, "you realize Who that makes us."

The fat man wasn't listening. His face was beaded with sweat. "That was fine," he said. "My God, Doctor, that was very fine." His eyes remained glassy for a moment longer, and then animation came back into his features. He broke the rifle and started to hand it to the foxy-faced man, then hesitated, and with an eager shy deference that was obviously foreign to so important a man, asked, "How long does it take to get him ready again? I mean, it's hours yet until dark, and I was wondering if it would be possible—"

The doctor smiled indulgently. "Always time for one more," he said. ■

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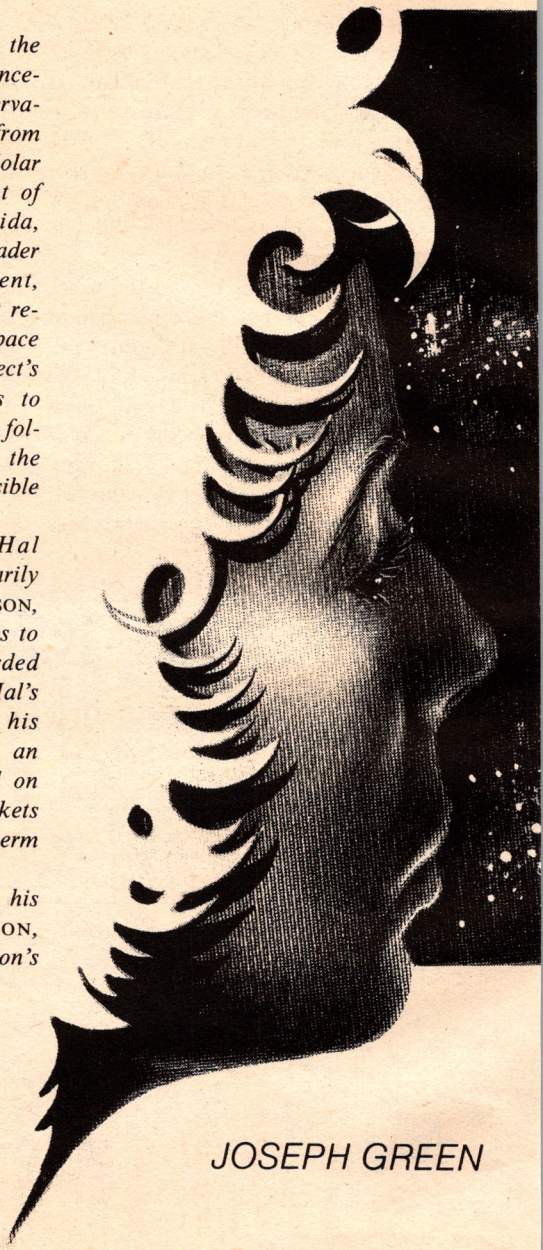
SYNOPSIS

On a Sunday afternoon in 2011 the world is startled by an announcement from the new lunar observatory, MoonEye, that a traveler from deep space has entered the Solar System. HAL HENTSON, *president of Rockets International in Florida, and* JODIE CARSON, *a Boston leader of the antitechnology movement, greet the news with very different reactions. Hal orders his deep space tracking team to monitor the object's speed and direction. Jodie flies to Florida and prepares to lead her followers in the New Friends of the Earth (FOE) against any possible attempt at interception.*

In Florida Jodie learns Hal Hentson is preparing to temporarily resurrect his father, JARL HENTSON, *by using new computer techniques to imprint the dead man's recorded neural patterns on the brain of Hal's idiot son, named* JARL *after his grandfather. The first Jarl was an astronaut, the first man to land on Mars, later the founder of Rockets International, and finally a one-term President of the United States.*

Hal has a painful fight with his wife, LILY BREWSTER HENTSON, *over his plan to utilize their son's*



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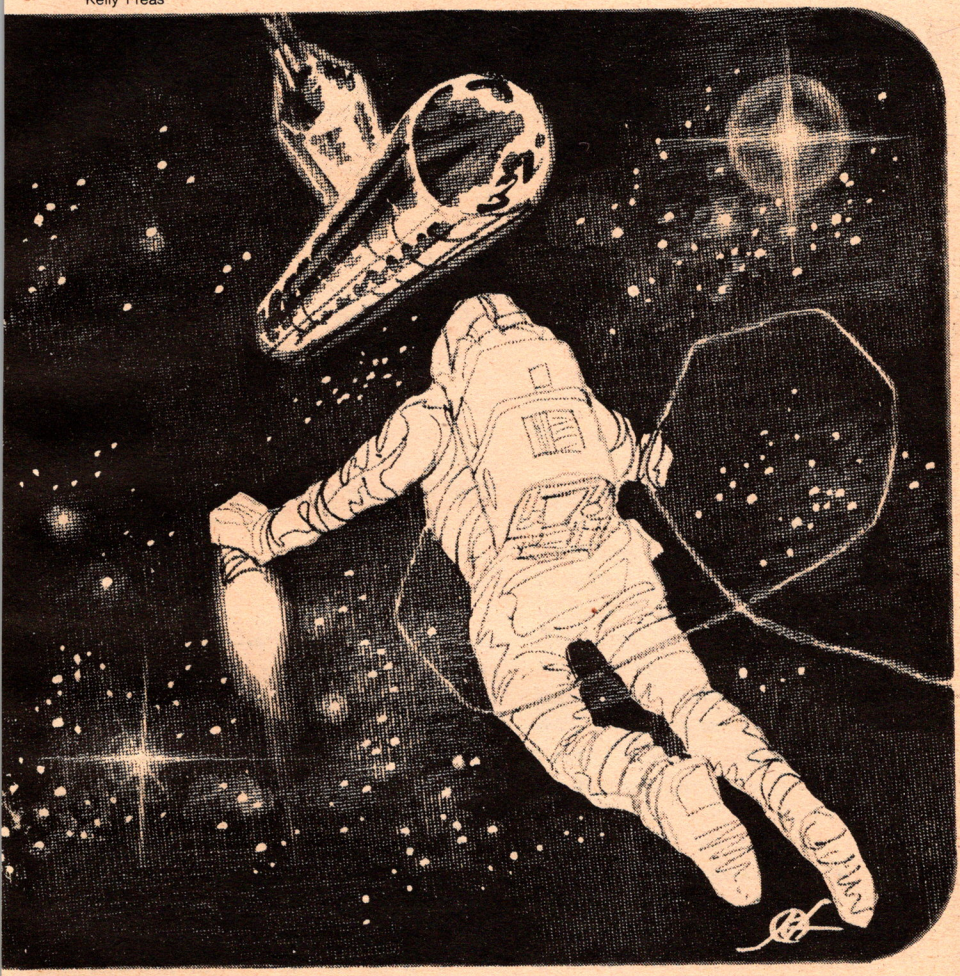


Conclusion. The makers of the probe wanted it to be captured—but not hijacked!

STAR PROBE

brain. Hal wins and takes young Jarl into the labs to start the imprinting operation. Hal wants to consult with his father about the unexpected visitor, which is apparently an automated probe from another star system.

Hal appoints an engineering study team, which reports that the largest rocket in stock can intercept the probe, but not return. The probe will arrive the next Monday, and perform a fly-by of Earth on its way to Saturn. The intercept rocket must be launched toward Saturn Sunday afternoon.

PAT PAJICK, *Hal's assistant, tries to locate an astronaut willing to sacrifice his life to capture the probe. Hal offers a million-dollar payment, but no one will volunteer. Hal, an experienced light plane pilot who tried and failed to become an astronaut, decides to go himself. His staff and friends talk him out of the idea. A light plane pilot could not absorb the amount of training needed in the time available.*

PEPI ASTURIO, *a close friend of Hal's and the company physiologist, suggests that if the imprint operation is successful a highly experienced astronaut will be available, one who would almost certainly volunteer—the elder Jarl Hentson's persona in the younger man's body.*

Hal automatically rejects the idea, since it would involve the sacrifice of his son's life. Then he has second thoughts, and finally realizes there may be no other way. For the moment he decides to start retraining his son/father in the company's flight simulator, while reserving the option to go himself if the imprinting is not fully successful.

Some of the members of the local FOE group work at Rockets International, and report the decisions there to Jodie. She decides to stop the planned launch.

Jarl Hentson the First awakes in the flight training simulator, with his mind deeply confused. He has memories up to age fifty-six, but is in a young body. He attempts to learn why he is training for a spaceflight when he has long been out of service, and the flight controllers refuse to answer and put him back to sleep.

WARDELL DAVIS, *the Government space agency representative at Rockets International, hears of the plan to intercept the probe and warns Hal Hentson not to try it on his own. Since Rockets International is primarily engaged in Government-paid space activities, defiance could ruin the company.*

Jodie and her FOE group learn that Hal intends to defy WorldGov and attempt to capture the probe. She arranges to have a thousand members gather at the launch site Sunday, so close a lift-off would kill them all. But she also learns from a young woman in the group, DIANA SHARP, *that Hal Hentson has a secret identity in which he relaxes on weekends, that of swinger Alexis Martin. Diana has had a recent af-*

fair with him. Jodie decides to kidnap Hal and hide him away until Monday, in the belief the launch can't proceed without him.

Jarl Hentson awakes again, this time with his mind almost clear. He is back in the flight trainer. The flight controller asks him to practice for a planned mission, one with strange requirements for the pilot. Jarl trains as directed, but demands to know what is happening. The controller tells him about the probe and the mission to intercept it, but refuses to discuss Jarl's correct age or the new body he is in. After the training session Jarl is put back to sleep.

The Government obtains an injunction against Hal and Rockets International to stop the launch. The FOE people announce they will crawl up the rocket nozzles if necessary. Hal goes out as usual on Friday night in his secret identity, to relax for a time.

At his regular nightclub Hal dances with Diana Sharp, but becomes intrigued with a lovely dark-haired stranger who seems new. Her name is Jodie, and she is there with a female friend named STROBE. *Hal dances with her several times, and stays with her until the place closes. Strobe has already left, and Jodie asks Hal to see her to her apartment, saying she is a summer visitor.*

Thinking that this has been an easy pickup, Hal drives Jodie to her apartment. She ushers him inside, and flicks on the light. Strobe is leaning casually against the wall, a gun in her hand. Jodie calls, and three men carrying a rope file out of the bedroom. They tie Hal up as Jodie introduces herself as the militant antitech protest leader, Sarcoma—but learns Hal has never heard of her.

Hal asks why Jodie/Sarcoma wants to stop the launch. She informs him she is a cancer in the tissues of technological man, and pushes him into a soundproofed bedroom. The door closes behind Hal, and he hears a lock click.

Left alone, Hal becomes afraid the FOE people will kill instead of release him on Monday. He persuades Jodie to untie him when she returns, after several hours. They have an argument about the worth of the space program, and Jodie leaves.

Jarl awakes for the third time, and finds himself in bed in the Rockets International clinic. Pepi, whom he knows, comes in and explains to Jarl what he is—a computer-generated temporary persona. They go for a walk, while Pepi brings Jarl up to date on the world situation. Pepi also explains that Hal has disappeared, and Jarl should sign a form releasing Hal from all responsibility for mission safety. Jarl learns Hal plans to go himself if necessary, and concurs that Hal is incapable of handling such a task. Jarl agrees to go.

The FOE people hold a rally in Orlando, and finalize their plans to

storm the launch site if the executives at RI go ahead without Hal.

Pepi, Pat Pajick, and some other company executives hold an emergency meeting. Carson Jamison, vice-president in charge of production, wants to call off the launch. Pepi persuades him to go ahead with the preparations, saying they can always cancel at the last minute.

Pepi reports that the imprinting has been even more successful than anticipated, and Jarl/Jarl is capable of performing the intercept. It is still a suicide mission, however.

On Saturday Hal tries to escape from his captors. He breaks up his bed, makes a prybar from the frame, and starts pulling the soundproofing off the bathroom window. It is very slow and hard work. Jodie brings him his dinner, and they have another argument about the space program. He eventually makes a crude remark so she will leave, and returns to work on the window.

Hal escapes through the opening he has made by swinging to a balcony in front of the apartment's living room. Then he drops to the balcony below. The occupant there calls the police, but the kidnappers are gone by the time they arrive.

Hal hurries home, where he calls Pepi. He learns the launch preparations are on schedule, and Jarl is ready to go. Hal collapses into bed for a few hours sleep.

Jodie finds Hal has escaped, and activates the back-up plan of invading the launch site. Young Jarl's physical therapist is a member of the FOE chapter, and she sends him to tell Lily what Hal is really planning for their son. They also learn the Government has obtained an injunction against the launch as expected, and it will be served Sunday.

An aircar takes Jarl from the lab to the Vehicle Assembly Building on the Kennedy Space Center, where he dresses in a spacesuit. As they leave for the launch site Lily appears, with a deputy sheriff in tow. She demands they release young Jarl to her, and the deputy backs her up. The first Jarl informs Lily he is the intelligence animating the body. Pepi puts in an emergency call for Hal, and they agree to wait until he arrives.

Hal reaches the scene minutes later, and informs Lily Jarl/Jarl is going; Hal alone is the legal guardian of their son. Lily tells Hal he has lied to her, and collapses in tears.

A thousand members of FOE gather at the state park across the river from the launch pad. They hoist the FOE flag and start across in a ragged armada of small boats. There being no way to stop them except by bloodshed, the boats land and the people swarm ashore.

A Federal marshal arrives at the launch control center and serves the no-launch injunction. Hal accepts it, and asks the marshal to have a seat. He then orders all available vehicles on the space center, from huge fire trucks on down to cars, to gather at the launch site. The guards begin ar-

resting the FOE people and hauling them away, but it becomes obvious the area cannot possibly be cleared in time to launch.

Hal has an idea, and consults with the launch conductor on the feasibility of firing the big rocket's vernier engines alone. When he learns this can be done, Hal uses loudspeakers to warn the demonstrators he is going to launch the rocket and kill them all—then ignites one of the verniers.

The flames and thunder create panic in the crowd, and they start scrambling to get away. The guards assist them onto the vehicles and start moving them out. Hal ignites the second vernier rocket, and the noise and flame double. When the last demonstrator is gone Hal asks the Federal marshal to observe, and he alone presses the button.

Hal calls Jarl by radio, to say he has done his part—but the toughest job, the actual intercept, still lies ahead, and success or failure rests entirely with Jarl.

Part III

From the Master's Thesis scrapbook of Jarl Hentson:

"But if we allow these Planetary Inhabitants some sort of Reason, must it needs, may some say, be the same with ours? Certainly it must; whether we consider it as applied to Justice and Morality, or exercised in the Principles and Foundations of Science. For Reason with us is that which gives us a true Sense of Justice and Honesty, Praise, Kindness, and Gratitude: 'tis That that teaches us to distinguish universally between Good and Bad; and renders us capable of Knowledge and Experience in it. And can there be anywhere any other Sort of Reason than this? or can what we call just and generous, in Jupiter or Mars be thought unjust Villainy?"

—Christianus Huygens: *New Conjectures Concerning the Planetary Worlds, Their Inhabitants and Productions (c. 1670)*

Chapter 11

Sunday, June 12, 2011

"Mr. Hentson, the judge will be in his chambers tomorrow at 9:00, and about 9:01 I'll be heading back this way with a warrant. Where can I expect to find you?"

Harold smiled at McDougal. "The plants are closed on Monday, but I'll be in my office by 10:00, to watch the contact. I'll wait for you there."

"Mr. Hentson, you won't be the first Big Pig I ever arrested," the Federal officer went on conversationally. The two men were walking out of the Launch Control Center toward the parking lot. "Once back in the Nineties I took in old man Roger Woodall, while he was head of GM. They refused to obey a Federal judge's order to shut down a factory that was polluting the air, and we didn't waste

any time with the Little Pigs—went right to the top."

"Yes, I read about it. And I also remember the order was appealed all the way to the Supreme Court, and finally overturned there. The district judge had exceeded his authority in ordering that plant closed without the required hearings."

"Yes sir. But they upheld a separate charge of contempt against Mr. Woodall, for refusal to obey a lawfully issued court order."

"For which he paid some small fine," Harold agreed. They were at the marshal's steamie.

"And you think that's just what you're going to do, don't you?"

"I hope so, but I don't really know. It doesn't matter. I did what I had to do. After that, you take your chances."

"Mr. Hentson, you aren't going to like it in jail," said McDougal. He started his vehicle, waited sixty seconds, and drove away.

As Harold looked to the west he saw one of the last fire trucks pulling into the southwest parking lot, its long body covered by a clinging swarm of people. A guard stepped down out of the cab, followed by a short figure in a bright scarlet pantsuit. There was something familiar in the smooth, easy way she moved. Harold made a hasty search, found a company steamie with the key inside, and appropriated it. Three minutes later he was pulling into a parking space near the milling crowd.

One of the guards spotted him and came hurrying over. "Mr. Hentson!—Uh, Hal! Now that we've got 'em here, what are we supposed to do?"

"Give the firemen back their vehicles. Use the vans and steamies to get all those back to their boats who want to go. See to it they leave the land. Tell those who want rides into Merritt Island to wait, and start running them down to the Orlando expressway when you have a free vehicle."

The guard hurried away to relay the orders. The apparent mass confusion slowly began to untangle as people decided where they wished to go. Most chose to return to the boats, but several knew they had lost their ride. They accepted transport back to the major east-west highway.

This crowd had cleared away from the launch pad in ten minutes, but it took them an hour to leave the parking lot. Harold kept watching for the bright form of their leader, but Jodie/Sarcoma had disappeared. Probably afraid he would have her arrested on sight.

Harold did see Strobe, and the young man named Sergio. The tall woman noticed his glance, and resolutely looked the other way. Sergio looked frightened. Harold let them leave without a word.

When only the area patrol guard remained, Harold started the company steamie and headed for the

exit onto the state highway. As he was passing through the gate a throaty voice behind him said, "Congratulations, Jesus."

Harold jerked forward, so startled he almost lost control of the car. Jodie laughed. "What's the matter? Nerves a little tight? Stop worrying; we aren't going to put you back in a cell. The Feds will do that for us tomorrow."

Harold risked a glance over his shoulder. She was sitting up in the rear, obviously after hiding on the floorboard. There was no weapon in sight. And as he stared, Jodie deftly eased over the seat and slid down beside him.

"Cocoa Beach, please. And hurry; I have to get to a bathroom."

Harold eased out into the sparse Sunday afternoon traffic. "What makes you think I won't turn you over to the police?"

"I saw you recognize Strobe and Sergio, and you let them go."

Harold was silent. The antitechs had already proven they knew his personal habits. Jodie was proving she understood his temperament as well.

"Incidentally, you've only won the first battle," Jodie went on. "My people tell me your own brains at RI have assured you the odds against Jarl Hentson being able to stop the probe are awfully high. And even if he does, World-Gov or ourselves will have you put away by the time it returns. You aren't going to get that second rocket you need off the ground."

"I'll worry about that when I know we need it."

"You *are* a stubborn one. But that just makes fighting you more fun."

Harold turned left at the intersection to Cocoa Beach. They were silent for the few minutes it took to cross Merritt Island and turn south. He was trying to understand this strange but still very attractive woman sitting by him. She enjoyed what she was doing, whereas most protesters he had met seemed grim and determined fanatics, true-believers in the worst sense of the word. There was an unusual vitality, an impressive life-force in this woman, one which should have been directed toward more worthwhile ends.

"Where can I drop you?" Harold asked as they entered the edge of Cocoa Beach, which straggled along the highway from the southeast gate of the Kennedy Space Center to the edge of the Patrick Internal Peace Base.

"Your secret apartment is in the Royal Twins, isn't it? And steam along, I'm about to wet these scarlet pants."

Harold steamed along.

It was almost dark when they reached his apartment. Jodie stayed inside the bathroom over half an hour, and Harold heard the shower running in the relaxorbath.

It was no surprise when the door

finally opened and Jodie stood there nude. There was something very primitive and direct in her eyes.

"Still want to settle this thing between us man-to-woman?" she asked, almost casually.

Harold felt his throat go dry. He was not stupid enough to think he could compete in sexual athletics with a woman ten years his junior, or with a woman of any age who wanted to use her body as a weapon. But that scarcely mattered. Here, as always, it was the joy found in struggle that counted.

Harold openly stared at Jodie. Some of his paid-for mistresses had been younger and more beautiful—but this was the most desirable woman he had ever known.

Harold was suddenly aware that he hadn't had a bath since Friday, that he had a two-day growth of beard, and was terribly hungry. He began shedding clothes—but walked toward the bathroom as he did. It was her turn to wait while he had a shower and shaved.

Monday, June 13, 2011

Jarl awoke from a hard sleep to find his neck stiff and his strong body growing increasingly weary of the constant weight of three G's. One zero-G period had been built into the flight plan, but it had been shortened by lifting off late in the launch window.

He glanced at the chronometer, and saw it was six o'clock Eastern Daylight Time. He had slept for five hours. And that was his second sleep period of the night. Rendezvous was to be about eleven this morning.

Jarl had to call Mission Control to alert them that he was awake. There was no electroencephalograph built into this operational helmet.

"Ready for some breakfast, Jarl?" the controller asked when he came on. It was the same smooth young snot who had first led him through his paces in the simulator.

"Hell, yes; I'm starved, as always."

"You'll have to prepare your own this time. The wall unit to your right is both a refrigerator and oven. Open the bottom door . . ." and the efficient young man led him step by step through the preparation of the usual frozen dish. This vehicle was intended only for short Earth-orbit flights, and not designed for pilot comfort.

When Jarl finished, the young controller said, "Let's run through the attitude-positioning exercises once more, Jarl, using the real controls. The results will be simulated, of course; we've got you cut off here. We'll feed the data into the flight computer and give you the projected results on your main screen."

Jarl went to work. He could feel old skills growing sharper with each practice session. Strange, how

much came rushing back when the right associations were exercised. And the odd, unexplainable upwellings of feeling that seemed foreign to his nature had ceased to bother him. He felt very much as though he was a complete being. But of course those parts of his memory that were missing simply did not exist, and he would have no way of knowing they were absent.

They were already far enough from Earth that a time lapse of several minutes was required for sending and receiving signals, forcing Jarl to pause after each action to await the result. But they were uniformly good when they came. The sensitivity required in handling a spaceship in zero G had returned.

There was a long break after Jarl finished the exercises, with Mission Control available but not talking. Jarl had little to do, and his thoughts turned to the oddity that was himself. It seemed strange that he would exist only for two weeks, when he felt almost normal. It was stranger yet that he should be here, on a suicide mission. He had always been a life-oriented person. But the logic of the peculiar circumstances had forced him into a decision he would not normally have made.

If he could live for only two weeks, and there was a chance he could do a truly great deed for humanity in that time, he had no choice but to try. The only sad part was that his grandson's body had to die, and there was nothing he could do about it.

Harold was also thinking.

They had gotten up at six o'clock and gone out for breakfast, then returned and promptly headed for the bed. They fell asleep after making love, but Harold soon awoke and lay looking at the slumbering face of Jodie. She slept with her mouth slightly open, breathing slowly but deeply. There were wrinkle marks at the corners of her eyes, and small lines on the neck. She was not a young woman. But the fire and intensity he had sensed in her had come out full-force in love-making. He had lost every contest during the night, as expected—but they had occurred as part of the most joyous struggle he had ever waged. Harold realized he had never met anyone at all like her—and his life had been the poorer for it.

Jodie opened her eyes.

The veil of sleep cleared away. She blinked several times and sat up, stretching and yawning. She glanced at her watch. "You aren't going to be in your office to meet the marshal at ten unless you get moving."

"The actual contact will be sometime after ten-thirty. I think I'll send him word to wait, and watch it from Launch Control. He might try to carry me away before

we know the results. Would you like to come along?"

"Good gosh, no! I can't afford to be seen with you in public! And I'm expecting you to live up to your so-called 'gentleman's code' and never mention this night to anyone. We both had the urge, we satisfied it—and now we can go back to our separate lives."

Harold had learned, during the night, just how separate those lives were. During some of the long long hours of quiet talking, between the arousing and satisfying of passion, Jodie had revealed a great deal about herself and her ideas. They were completely alien to Harold's experience, jarring in their totality of opposition to what he believed.

"We exist as artificial entities, self-created human artifacts," Jodie had said, sitting up in bed and drinking from a glass on the book-end headboard. "The machines have separated us from our senses, so that we perceive with only half our ability. We are only half alive." The curtains were drawn back from the single window, letting small fingers of moonlight into the shadowed room. In front of the building the Atlantic tumbled in phosphorescent splendor toward the beach—but they could not see the water from the bed.

"We are so proud of our civilization, of our great machines and our mighty industries. But in fact, the most primitive savage left in the Amazon jungle is more alive than a corporation president—such as yourself. That savage *feels* with his hands. He *smells* the world around him—both the pleasant and the foul. He is *aware* that he exists, and in harmony with his environment. Every moment of the day, he *lives!* Can you understand me? His life is richer, more full than yours and mine because he exists at a higher level of intensity. He *uses* his body constantly, and, with him, muscle and mind are one."

"Then you reject the oldest teachings on which Western civilization is based, the dichotomy between mind and body formulated by the great Greek philosophers? You equate sharper physical senses and stronger muscles with quality of life? Then the elephant must be superior to Man—he's certainly stronger and has better senses—and the lion must live more intensely."

"But of course! *All* the wild animals lead lives more satisfying than ours! They live as nature intended, and have no troubles caused by intellect. Yet they have all the intelligence needed to survive within their world."

Harold could only shake his head in wonder. There was no doubting her sincerity. "Then what you would really like is to see civilization fall, forcing us to return to living in the woods. Our lives might be shorter when the tigers came hunting, but we'd live more 'intensely'."

"Exactly! But I don't tell even

my most devoted FOE friends what I've just told you. Even they don't carry logic to its end, see the final result we should be striving for. I concentrate on the space program because it's easy to show how wasteful and corrupt it is, and how little it returns for all the money and effort. But they think in terms of devoting those resources to more worthwhile projects. I don't. The technology the space program has spawned should die, not be transmogrified."

"You use a lot of words that stand for very abstract concepts. Would they exist in this primitive world you're describing? Could you even make this argument without the words?"

"If we were total primitives there would be no need for the abstract. The concepts would not exist, nor would they be missed."

"I doubt that." Harold was quiet for a moment, then said, "Let me tell you a story my father told me, when I was a small boy. Yes, he held me on his lap and told me stories, just like any other father and son, if that's what brought that skeptical expression to your face. The publicity gimmick you people came up with of calling that man 'God' Hentson—" Harold shook his head at the absurdity of it. "Anyway, it happened during his second year of college.

"An Indian Yogi visited Harvard and lectured to the class. He was the genuine article, not one of your thousand American imitators. He let the physiologists strap him into various machines, and demonstrated how he could control his breathing, slow or speed up his heartbeat at will, expand or contract the large intestine, and so on. He had attained what you describe as an awareness of the body. The instructor called it partial command of the autonomous nervous system. And of course the Yogi told them how important self-understanding was, and presented himself as a man who had devoted years of his life to practicing internal physiological control. He said he could do things with his body Westerners couldn't, and proved it. He made it all seem very impressive. He was also a man at peace with himself. My father said he had a sort of gentle air about him, a calm self-possession the students envied. He must have been about fifty at the time, and appeared to have no worries or cares. He refused to accept money except for his expenses. And everyone thought that surely this was a man to be emulated."

Harold stopped, lost in thought. "Go on," Jodie prompted.

"During his second week at Harvard he was demonstrating internal cleanliness—where he sucked water up into the large intestine, swirled it around, forced it back out—when he got a very surprised look on his face and stopped. He appeared to be in pain. He got out of the tub and dried himself off. Dad noticed

he was leaning forward slightly, unable to stand upright. The rest of the class left, but the next period was a free one for my father, and he hung around. The ambulance came for the Yogi a few minutes later. He was taken to the university hospital, and operated on for a burst appendix."

Harold took a long swallow of his drink. "Oh, the story has a happy ending. The operation was successful, though the Yogi had waited too long while attempting to 'cure' himself by internal control—which did include the ability to ignore pain. He recovered his health, finished his tour, and went back to India. But the incident made my father think. All those years devoted to patiently developing control over the nerves to his large intestine—and when trouble came, in a vestigial remnant of it called the vermiform appendix—he couldn't do a thing for himself. An appendectomy is a very simple operation by our medical standards—but he would have died without it."

"So-o-o? He probably lived five real lives within his fifty years, compared to Jarl Hentson—or that surgeon who saved him, or you for that matter."

"I can't believe that. But the point of the story is that science and technology are life-enhancing, not life-destructive. By gaining control over the external, material world, we achieve a far greater ability to correct malfunctions within our own bodies. Plus the benefits of a steady food supply and freedom from enemies, the other primary needs internal control can't provide."

Jodie was a small dark body leaning back against the headboard. He could just make out the soft blur of white skin, see the darker tangle of black hair behind her head. She leaned forward to lightly kiss him, a prelude to the regeneration of passion, and said, "The Yogi is probably dead now, along with the surgeon, and neither of them could have convinced the other, and neither will you or I. When your marvelous science can show me a *long* life—say about ten thousand years—then I'll accept that as a substitute for a more fulfilling and intense one."

"If we are to have a chance at immortality it will come through science, not Yogi," said Harold—but the soft lips returned to cover his, and for a time he again lived very intensely, and without words.

Chapter 12

Monday, June 13, 2011

"Jarl?" The smooth-faced young controller was back. "We have a good radar track on you both, and are allowing for the time lag. Once you've turned around and aligned yourself in its path, you will start by going into full reverse thrust. As the probe comes to you, ease off. If it takes evasive action, move to the opposite side and let it pass. We'll

start up the main drive again and try to get close enough to disable the engines with your laser."

"Wouldn't it be safer and simpler to come up behind it and hit those engines in the first place?"

"We'd rather have them undamaged, if possible. It's about three klicks to your right at the moment. Move your right window shield and take a look."

When the metal plate slid aside Jarl saw the probe. Sunlight outlined a shape like a gigantic egg, large end leading. The angle of travel let the light reach past the center of the rounded nose, so that the side toward him was partially lighted in front but otherwise in deep shadow. The color was a bright and shining silver.

The two engines at the tapered rear were partially set into the line of the body, only the nozzles breaking the symmetry. They seemed small for such a bulky ship, but produced a giant cloud of blue fire. Jarl wondered what design considerations had led the alien builders to select such low-thrust devices. Were there advantages Earth engineers had overlooked because of the limited burn-time available on all prior rocket engines?

"Your main drive will be stopping in about two minutes, Jarl. Start the right yaw maneuver as soon as you lose power. While we're waiting, go ahead and set your maneuvering engines for reverse thrust."

Jarl complied, and settled down to the remembered task of piloting a spaceship. He was on his own now. The time-lag was too great for help from Mission Control.

The timing was virtually perfect. When he completed the turn and found himself looking through the spidery skeleton of the attach fitting, Jarl was less than two kilometers from the probe. From this front position the visitor did not seem large or impressive enough to be an interstellar vehicle. But it was far more advanced than anything Earth could produce, when he had been an astronaut. Or even when he had . . . Jarl chopped off that thought. Death was not a part of his memory. There was no need to dwell on the fact it had happened.

The gap between the two ships was swiftly narrowing. Jarl started the two maneuvering engines and eased them up to full thrust. The drag he had momentarily lost returned, though at less than one G. After a moment the distance between the two ships seemed to stabilize. He cut power slightly, waited—then cut it again. The probe came steadily forward, the cloud of dark blue fire filling space behind it.

Jarl let it gain on him, trying to estimate the relative velocities of the two vehicles. An indicator on

his panel gave him a distance readout in meters, but he ignored it, preferring his own eyes and judgment. And slowly, slowly the gap narrowed, the silver egg boring relentlessly through space toward him, growing larger and brighter as it came.

The probe seemed to be ignoring his presence. That in itself was significant. Its many mechanical sensors must have long ago detected this intruder, queried the dispassionate electronic brain, received commands to execute. Possibly there was a limit beyond which no physical body could approach—and at that point the burning finger of a laser would reach out to cut him apart, or a small warhead would come streaking toward the Big Bird.

There was no way of knowing. His sole weapon was a laser cannon, and it was intended for offensive usage. They had not even bothered to give him training exercises in fighting off an attack.

The gap grew smaller still, and there was no reaction from the probe. A moment later a shadow from the attach framework fell across the silvery nose. Jarl fed his maneuvering engines a bit more thrust. Before he could try another speed adjustment there was a hard bump. He cut power and put the attitude jets on automatic.

"Contact!" he said to the passive face of the flight controller, knowing it would be minutes before he would see the excitement that word generated.

Jarl took his hands off the controls, clenching and relaxing them. He suddenly realized how great the tension had been.

Jarl was too close to the rounded face of the probe's nose to see the blue fire behind it. But the huge cloud generated enough light to brighten space beyond the shining metal horizon—and as Jarl stared, that light faded and died.

Jarl sat for a moment in stunned silence, feeling the sudden and unexpected weightlessness. Then he reported the event to Earth, just as the young controller's face lit up with the excitement on hearing contact had been accomplished.

"Now that I don't need to get inside and disable the engines, what's our next move?" Jarl added. "Have the bright boys behind the screen been working on contingency plans?"

There was nothing to do but sit and wait while the time-lag caused the curious phenomenon of instant history—all their reactions were in his past. But when the buzz of speculation died down the controller regained his professional calm. "Jarl, it's the fast consensus here that the probe recognized intelligent contact and turned itself off. It *wants* to be captured!—which was one of the contingencies considered here, but nobody believed it. Now they think we should start your main drive again and slow

you both down without attempting to disable the engines. No one believes they will come back on."

"No, we're going ahead with the boarding as originally planned," a strong new voice cut in. The image of Harold Hentson appeared on the screen, a broad smile still on his face. "The best we can manage with the Big Bird engine is to slow you both enough to pass around the Sun in that tight loop. Jarl—get outside and see if there's an entry hatch you can open. Maybe we can do better."

"And just what did you have in mind, Wild-Hair?" Jarl demanded. He had to wait an interminable time for his answer.

"The experts have all agreed you couldn't possibly understand the alien programmer well enough to command the probe. Let's get inside and see if they're right. If they are, we lose nothing we're not prepared to lose. If they're wrong—perhaps you can save my son."

"Do we have the time?" Jarl asked.

When the question reached Earth, Harold briefly disappeared from the screen. He came back to say, "Sure, we can spare a few hours. The trackers will tell us when the trajectory starts to get critical. Now get yourself out there and see what you can find, old man."

"Watch how you talk to your father!" Jarl growled, but obediently started unbuckling himself. Since he had never removed his spacesuit, he had only to check his oxygen supply and a few other readings before he could open the inner hatch.

This huge but cheaply designed space-going tanker-transport had a cheap airlock—and went to that small expense only because it was required to dock with the Space Station. It was a plain metal box, intruding into the pilot's compartment from the outside hatch. Both pressure doors were hand-operated, and the air inlet was a simple valve into the interior of the room, the only pressurized area on the vehicle.

Within five minutes Jarl was ready, and released the inner door pressure latches. From inside the cramped air lock he operated the manual valve that swiftly bled the air into the vacuum outside. After that he opened the outer hatch and pulled himself through, twisting his body to place his feet on the metal skin. Magnetic shoes locked him in place.

The light but sturdy gridwork connecting the two ships had plastic bumpers on the ends touching the probe. The attitude jets kept the two craft firmly in contact. Jarl was standing inside the framework, looking at the round silver nose only meters away.

The point of entry was obvious. There was a fine line forming a circle about a meter wide, around what appeared to be the point

where a line drawn through the long axis would emerge. There was a small indentation at that point.

Grasping the nearest beam, Jarl freed his feet and pulled himself along the framework to the other ship. To his pleased surprise the silver skin was weakly magnetic, at least enough that his shoes worked. He attached himself and bent over the small hole he was obviously supposed to examine.

Jarl kept up a running commentary into his suit mike as he moved. He was expecting a puzzle of some sort as the entrance examination, and was not disappointed—but it seemed so simple he wondered if it was not deceptive, and he had missed its meaning entirely.

The indentation was about four centimeters deep and as wide as the palm of his hand. Inside its perimeter was a series of round rods half a centimeter in diameter, their tops even with the metal. On each little rod was a single sharply-cut line, at varying elevations and on the inside face only.

Any creature of even reasonable intelligence should recognize the circle motif, and that it was time to form a final circle. This door was not intended to be difficult.

Selecting the rod with the lowest line, Jarl pressed gently on the one to its left. With his gloves it was difficult to move only that one, but he caught it just on the edge and succeeded. It moved easily enough. He stopped when the horizontal cut was even with that of the lowest one, and moved to the rod on the other side.

When all the rods were down a new circle had been formed, that of the aligned cuts. And their tops formed a jagged pattern—another circle, turned at an angle to the first.

A few seconds later the round plate moved slowly outward, extending directly ahead on a central shaft. When it stopped, the door was its own width from the main body.

A light came on inside.

Jarl pulled himself over the curving edge and into the hole. No creature much larger, and wearing a spacesuit, could have made it between the round edge and the immovable extended shaft.

He was in a cylinder of open space, two meters wide and five deep. The shaft ran its full length, emerging from the rear wall. A line of metal rods five centimeters wide and fifteen long wound around the shaft in a regular pattern, from one end to the other.

Jarl grasped a rod and pulled himself along the shaft. As his hands moved his eyes were trying to comprehend what they saw on the concave surface on all sides. Some of it seemed to make sense, to form a possibly understandable pattern. But much of the alien equipment he could have reached and touched, failed to register

properly. His sight could absorb the details, but not his brain.

When he was almost to the rear wall a round section of blank plate to his left warmed to a dusky red, then faded into shades of pale violet.

Jarl had been talking continuously into his mike, without giving the controller a chance to answer. Since the nose hatch was still open, his signal should be reaching the Big Bird, and from there going to Earth.

The violet-tinted plate extended itself slightly from the wall. Streaks of color circled around the perimiter, whirled, broke—and an image formed.

Jarl was looking down the length of the cylinder he was in. It did not show him there, which meant this was a recording. As he watched, the view began to move along the shaft, until it seemed to reach his present position. It turned toward the wall to Jarl's back. Then he felt a slight vibration of metal, and swung around. A larger section of wall had moved out and tilted downward, within arm's reach.

There was a seat of sorts attached to the curved plate, at a lower elevation. Jarl seated himself in it, glancing quickly at the inevitable series of rods extending upward above the plate's convex surface. Three red screens had erected themselves at the far end, and were swiftly warming up to violet.

Jarl turned back to the main show, where an image of the controls he was facing had appeared. And, finally, he saw one of the builders of this automated marvel.

A creature appeared from the side and seated itself in the chair Jarl was occupying. It was humanoid in form, but with a body composed of a series of circles. The trunk was wide-hipped and narrow-shouldered, the belly fat and round. The head was shaped like a billiard ball, hairless, with a wide mouth upturned in a perpetual smile. It had ears, but they were flattened against the bald skull. There were two recessed eyes above the mouth, but no nose or nostril slits that Jarl could see.

The humanoid wore a loose-fitting gown that hung almost to its knees; these scenes had been shot in a gravity environment. The two legs beneath the gown were short and sturdy, and well bowed. The bare arms looked muscular and strong.

Judging by its height in the chair, the humanoid could have been only about a meter tall. But its bulk was so wide and stout it would have equaled a human in weight. The closest Jarl could come to classifying it in Earthly terms was as a very sturdy gnome, or human dwarf. He decided to think of it as a gnome.

The alien extended an arm and clamped a broad hand around the left rod in the line closest to the

chair. He pressed down—and the scene shifted without warning or fading, to an exterior view of the silver probe. The engines were off. But as Jarl watched, blue flames spurted from both, and swiftly increased to a huge, fire-shot cloud.

Just as abruptly, the scene returned to the interior, showing the gnome's hand on the rod. He lifted it back to the top of its travel—and the fast scene change came again, showing the engine fire fading away.

Jarl turned quickly from the screen to the real control board. That left-hand rod was in the up position.

So you started the engines just by pressing one round rod to the bottom. Simple enough. Like the entrance "puzzle," it was not meant to be difficult. Some of the others must be attitude jets and internal ship controls. But how did you steer this thing? And what did you use for orientation and guidance?

In a step-by-step, logical, orderly sequence, the screen proceeded to teach him.

The alien thought patterns were not really that difficult to understand. The major item that seemed to distinguish them from the human was that evidently they did not use identification symbols on their controls. Every rod had a separate function, and together they formed an easy-to-operate manual control system—if you could remember what each one did. Since there were over twenty of them, it wasn't easy.

Jarl settled down to learning how to operate his second new ship within a week.

He had one lucky break. When the gnome at the controls had run through an entire operational sequence, he touched a final rod that controlled the instruction screen itself. He depressed it only slightly, the immediately raised it. The screen faded back into red patterns, but warmed to light violet again—and the instructional film started repeating itself.

Jarl avoided touching the lever that could change the program. He had a great deal to learn here.

"Hal?" The speaker was Wilson, the launch conductor. "That Federal marshal is on the visiphone. He wants to know when you're coming back to the Tower."

Harold glanced at his watch, startled. It was past twelve o'clock. He had become so absorbed in listening to Jarl's steady reporting he had not realized how the time was passing.

Harold stood up, stretching muscles cramped from sitting almost motionless for two hours. The TV camera on the front of Jarl's ship was sending back an unchanging view of the nose of the probe, with its round hatch extended almost a meter toward the attached intercepter. But though they had only Jarl's verbal description to go on,

the drama that had unfolded inside that odd door had kept them glued in their seats.

"I'd better go on to jail, or McDougal is going to die of apoplexy. Wilson—will there be any problem transferring enough oxygen from the Big Bird over to the probe to last for two weeks? Pete"—Dawson was sitting at the next console—"do we still need to loop around the Sun? If so, can we move out to a safe distance, using the probe's engines, and still get back here within the two weeks? We want Jarl back alive and the probe slowed enough to enter Earth orbit. Is that possible?"

Peter Dawson had obviously been mentally working the problem as they waited. Logical and orderly as always, he laid it out for them. "Hal, we still have to go around the Sun. It's already too close to turn now without going well inside the orbit of Mercury, and facing unacceptable heat. Our safest bet is to go ahead and fire the Bird's engines for the four hours we have left, discard it, and make our final calculations on the retrograde decel of which we know the probe is capable. I'd say we can keep it at least sixty million klicks from the Sun, at a rough guess, and get it back here within two weeks by constant use of the probe's engines."

Wilson had been waiting to speak. "Hal, the extra oxygen was installed in a separate tank, which Jarl can easily move to the probe. But unless he can close that hatch and have an air-tight room, he may have to stay in his spacesuit the whole two weeks."

"Any reason he can't live in the suit?"

"It would be damned uncomfortable, and he couldn't eat. We can add water to the suit-tank with it pressurized, though, so he could survive."

"Why don't we plan for the best possible answers, and accept less when it happens. Pete, I want you to take full charge of this mission until I'm out of jail. With luck, Fred Buck will have me free by tonight. Get Jarl to transfer food and water as well as the oxygen after he fires his engines. If he can close that hatch he could release just a little gas, and wait to see if the pressure in the probe stabilizes. Before he does that, in fact the first thing we should ask of him, is to move a camera over. Call out the rest of our science lab staff and let them have a look inside. Put them all on standby here for consultation. Get opinions as to whether releasing oxygen into the probe might cause an explosion, or any other damage. In short, carry on."

Pete looked a little stunned. He had just been handed a responsibility he apparently did not want. But he nodded, and turned to his console visiphone.

Harold decided to drive. Before one o'clock he was pulling into his

parking slot at RI Headquarters. He found McDougal sitting in the president's office, eyes still locked on the desk screen Pat Pajick had tied in for him. The marshal seemed well aware he was the only non-RI employee fortunate enough to be watching history in the making.

Pat Pajick had hurried inside behind Harold. "Fred Buck left a few minutes ago for Orlando. He's going to try to have the paperwork filed by the time you get there. If the judge won't release you on bond—and he may not, for a severe contempt citation—Fred will take it immediately to the senior jurist on the Federal court of appeals."

"Just so he has me out by dark. And see if you can arrange to have a visiphone installed in my cell, if I wind up in one, and pipe in the show. In fact it's probably time we contacted the Tri-D networks, let 'em in on it. They can carry it as a news event; no sponsorship. Tell them . . ." Harold stopped. He was about to get involved in a whole new area, and this was not the time for it. "Hell, put out an all-points visibull. Pete Dawson is in charge of RI until I return. Take it up with him."

McDougal reluctantly rose from Harold's chair, and the steady view of the probe's nose. Jarl was almost ready to fire his ship's engines. The officer looked at Harold with new respect. "Well, Mr. Hentson, it looks like your crazy idea wasn't so bad after all. If this works out, I guess you won't spend much time in jail."

Harold clapped him on the shoulder. "Maybe not even long enough to catch a nap. But let's get going, before that tough judge has you in there with me for being so slow."

"Yes sir, we had better be moving all right, before the afternoon traffic starts."

Harold left for his second confinement in three days in a cheerful frame of mind. From here on, always assuming Jarl's mind held up and the probe was ultimately captured, it should be a downhill slide to home.

Chapter 13

Monday, June 13, 2011

"Hey Jodie!" Strobe sounded excited. "Al Murray just broke in to say God, Hentson captured the probe, and is about to go aboard and fly it back! RI is going to furnish WWN live coverage from space. Want to watch?"

Jodie reluctantly sat up in bed and yawned. She had been taking a late afternoon nap, having gotten little sleep on Sunday night. She wondered how Hal Hentson felt. Probably good, if his father had actually managed to intercept the probe.

The program was on the Tri-D set, but being broadcast flat. And the audio link between Jarl and KSC was not being relayed. In-

stead, Alfred Murray was keeping up a running commentary.

"Fellow world citizens, that's Jarl Hentson you see moving toward the probe, carrying his supply of frozen food. We're told he's already transferred all the bottled oxygen he has, and the water. They thought of bringing over a radio, but that wasn't practical, and his suit radio won't reach this far. When the two vehicles separate we're going to lose contact with him, unless the probe has a radio and he can learn how to operate it. He claims to have already learned how to fly this strange visitor."

Jodie saw Jarl wriggle over the edge of the out-thrust door and disappear. "As we understand it," Murray went on, "RI now says the probe was *meant* to be captured, and Hal Hentson, president of RI, was right all along. He's in jail in Orlando, Florida, by the way, on a Federal contempt charge. Now Jarl Hentson, who is Harold Hentson's son—and also his father, according to what we hear, but we're not supposed to talk about that—has a camera set up inside the probe, and RI has promised us a look before they separate and the camera loses power. After that—hold it! Here's the RI acting president with some words for us."

The view did not change, but a new, somewhat halting voice replaced Murray's. "Fellow citizens, uh . . ." Dawson was evidently aware of the size of his audience, and bothered by it. "We are, uh . . . almost ready to separate the ships. We're going to switch you to our second channel, for a view inside the probe. It's a—a little hard to understand, some of it." As he spoke the static scene of the probe's nose abruptly vanished, to be replaced by an inside view of an apparently long round cylinder. It was like peering into the interior of a barrel, except that the walls contained hundreds of items of equipment, some of it of incomprehensible purpose. Jarl Hentson was stuffing cartons of frozen food into an opening behind what appeared to be a solid block of red steel. He locked them in place with tape.

"Our power system is not . . . well, compatible with theirs, and we can't operate the camera except on a cord from our own ship," Dawson went on. "We'll switch to the outside camera and let you watch Mr. Jarl Hentson fire up the probe's engines, but when he pulls away, that will be it until the probe returns to Earth. Just a few minutes more and I think he'll be ready."

Dawson fell silent, and the wrinkled but somehow ageless face of Alfred Murray briefly appeared, before the exterior camera view returned. Jodie and Strobe watched for almost an hour. They saw the Big Bird disengage from the probe, and retreat and lower itself. The probe remained on camera. Two of Strobe's friends entered, and silently joined them in front of the

set. Finally they saw the probe's engines come to life, and watched the silver stranger move ahead and abruptly out of camera view. The fatherly visage of Murray returned, to tell the world the worst was over, and with luck they would have the captured ship orbiting the Earth within two weeks. And he mentioned again that Harold Hentson, whose daring and imagination had made this extraordinary scientific adventure possible, was residing in an Orlando Federal cell.

"But he won't be for long," said Strobe, rising and turning off the set.

"Sarcoma . . ." it was Diana Sharp, the lushly pretty black-haired Latin girl who for a time had been Harold Hentson's lover. "Do you really think . . . I mean, did we do the right thing? Not that it mattered in the end, but . . ."

Jodie let surprise show on her face. "Why of course we did! And the fact we lost one battle doesn't mean the war is over. We can get our lawyer to file a petititon as a friend of the court—*amicus curiae* I think they call it—to get Jesus Hentson sentenced for a few months on that contempt charge. We can organize a protest at WorldGov in Geneva—in fact that will be my next job—to demand the probe be sent on its way again after they get it back here. What right did we have to interfere with it anyway? We can suggest they take God Hentson off first, for humanitarian reasons. Our basic thrust can be that MoonEye and the Space Station and all the rest already take up far too much of our resources, and trying to learn a new way of powering a rocket by studying the probe will be just throwing good money after bad. Why do we *need* more powerful rocket engines? We've explored the whole Solar System with unmanned spacecraft, and landed that crew on Mars. What has it all gotten us? Absolutely nothing! We shouldn't have any real problem convincing WorldGov we can't afford the billions it would take to understand and develop the technology on that thing. Besides, what if its owners come after it someday?"

"RI is claiming it was *supposed* to be captured!" Diana reminded Jodie, her voice a little high. "That's why it had the manual controls and everything. Before I came over here I heard that a Space Benefits scientist says it will almost certainly have some kind of message on board, telling us how to contact the builders by radio. We won't *have* to actually fly to their home star! It will take years and years each way, but he says that once we know where to point our largest radio telescopes, we can send and receive information. After we learn each other's language, that is. And maybe there's some sort of book or something on the probe that will even tell us that!"

Jodie stared at Diana, her face

cold. "There are all kinds of 'maybes.' Maybe it will have a better liquor-making machine inside, and we can all get drunk! But we know for sure that if Space Benefits funds anything of the kind, the money will be spent on hardware and not on *people!* The real point is that we have too much technology *now!* Let's don't make the situation worse by adding a whole new batch before we learn to use what we have."

Diana rose to her feet. "I think I'll be going. I don't agree with what you're doing, and I don't want to help anymore. In fact I'd apologize to Hal Hentson for fingering him, except that he doesn't know I did it, and he got away from you anyway. I joined FOE because I believe in its goals, Sarcoma. But you've turned those into something senseless and sick! Oh, don't look so shocked and worried, I won't tell anything I know. I don't want to join Hal in jail!" And she hurried out.

Jodie stared at the closing door with somber eyes. This defeat was more serious than she liked to admit. Diana might have been influenced by the fact that she was obviously still in love with Jesus Hentson—but a lot of people were going to share her views. Which made going to Geneva and stirring up the FOE chapter there all the more urgent. Two weeks advance work should be enough to ensure a really massive turn-out. The Hentsons could still be stopped.

Hal's face swam into her mind, and for a moment she was drawn back into their long night together. She felt a pleasant stir of warmth at the base of her spine. It was odd that he could be such a considerate, gently fierce man as a lover, and yet have so little regard for people in general. But perhaps that was one of the dichotomies possible when one had a closed mind.

"Care to take a couple of weeks off and go with me to Geneva, Strobe?" Jodie asked.

"Me? Migod, Sarcoma, I can't afford it! I've used my leave for the year, and I don't have the money anyway. We have Jan Stugart there, she can do more for you than I could anyway."

"Probably so," said Jodie, rising and heading for her bedroom. She still felt somewhat tired and listless. "I'll pack in the morning. Give my regards to the chapter at the next meeting, and tell them it was a job well done, regardless. Next time we'll cut the Hentsons and SB down to size."

"Yeah. Next time," said Strobe dutifully.

Jarl sat in the oddly curved seat, facing the front of the closed room. The large screen on which the operational instructions endlessly repeated themselves was to his right, the three screens which were a part of the control mechanism directly ahead, behind the banks of rods.

He had closed the entry hatch before activating the engines. With the probe in motion he felt a comforting weight again, though it seemed less than half a G. His back was pressed against the seat firmly enough that he felt its different curvature as uncomfortable. But it was something he could easily endure.

He glanced at the external pressure gauge on the arm of his suit. It was registering almost half a kilogram. He had just turned off the valve on the oxygen tank, and the big question now was whether the pressure would hold. If it did, he could release enough more to build up to two kilograms. That was a thin atmosphere, but breathable when it was pure oxygen.

Jarl had tried peering behind the various extended panels in the curving walls to see if there were openings to the huge spherical interior. If there were, he had not been able to spot them. As with the outer walls, the inside surfaces that he could see were a maze of equipment.

The three screens on the front of the convex control panel were from three exterior cameras. He had not yet discovered any means of viewing the interior of the probe. The center camera showed nothing but a swirling cloud of blue fire, streaming constantly backward. It was obviously mounted near the engines. The other two were front-mounted, widely apart on each side. They showed star fields ahead. And by swiveling the one on the left, he could see the Sun.

The controllers on Earth had used the thrust left in the Big Bird to change his velocity, but not the direction. Before cutting off the TV they had fed him a complete flight plan, once convinced he could actually guide the probe. At the moment he was still decelerating. When he stopped the engines after 196 minutes, he would be in a flight path that would take him just outside the orbit of Venus. Once past the Sun he was to ignite the engines again, and actually accelerate for four days. That was the maximum added velocity the probe was capable of shedding before reaching Earth, and took nine days off the time the wider orbit around the Sun would have otherwise required. Then there would be seven straight days of deceleration toward Earth. They had not been able to compute his exact arrival velocity, but felt certain it would be slow enough to put him into an elliptical Earth orbit.

Jarl glanced at his watch again, and saw that less than three minutes had passed. His gauge still read half a kilo, but that meant nothing over such a short period of time. He could only hope this odd little control cylinder was as isolated as it appeared, and that it would hold oxygen. He was already feeling uncomfortable, and tired of the heavy spacesuit.

At the end of an hour the external gauge read exactly what it had before. So the area was tight, at least up to that pressure. He was going to quadruple it, and there was always the possibility something might give. If it did, and all the air escaped, he would soon be dead.

Jarl hesitated. Did he have the right to risk his life? He could assume the gnomes had anticipated this need, and deliberately arranged for the little cylinder to hold whatever gas mixture a visitor needed. Which meant the rods, screens, and all other surfaces were made of extremely passive materials, to avoid reactions with corrosive gases—such as oxygen.

On the other hand, he could be guilty of anthropomorphizing.

Despite that possibility, Jarl would have been willing to bet the gnomes were oxygen breathers. There were more similarities than differences between them and humans, at the macroscopic level. What a micro-biological exam might show was anybody's guess. If they were as thoughtful and careful in their preparations as it appeared, this little room would hold almost any atmosphere, and he could unsuit in perfect safety.

And if he was wrong, and some fragile panel sprang a leak under two kilos of pressure, the probe would not be captured. There was no way of predicting what its program required after an intelligent entity had entered the manual control chamber. But it was not likely to reverse course and land itself on the last planet scanned.

Which threw him right back to the beginning. Was he convinced he understood the alien thought processes well enough to risk it?

Jarl decided he was. He opened the manual valve on the oxygen tank to maximum, and waited. When the pressure reached two kilos he turned it off and unsuited. There was no use in waiting for stabilization. At this point he had either won or lost.

It felt good to be outside the confining suit. It felt even better, after about an hour, when the pressure had stabilized at just below two kilos, and there had been no reaction from the visible equipment or the inside of the probe.

There was nothing more to do while waiting for the time to cut off the engines. And he felt reasonably confident he could operate the control rods from memory now if he had to. Jarl reached for the one he had been warned would change or stop the repeating program. He depressed it, and watched the fat gnome fade from view on the large screen. With the rod at the bottom of its travel, he rotated it to the left—and a new program appeared. Again without introduction or sound, it started playing across the concave round surface.

This story began with the probe in orbit around a large, reddish-col-

ored world, hulking huge in the background. The probe was apparently complete, ready to depart. But then it began disintegrating, breaking into component parts. Small ships of a totally different design appeared, and began taking each component back to the surface. And then Jarl realized these people presented history from present to past, not in chronological forward order as was the human custom, and settled down to learn.

Monday, June 27, 2011

"It's one after four; let's go," said Sanderson. He led the way out of the thick brush toward the tall fence, carrying a collapsible ladder. Jodie followed, after looking carefully around. The bearded young guidance engineer had assured her the man on duty inside the Launch Control Center was a FOE member, and they would be seen on monitoring screens but not reported. The guards on patrol were not, and had to be avoided.

Sanderson set the ladder against the overhanging fence and hastily climbed up. He crouched on one of the supports that extended the barbed wire a meter outward, and waited for Jodie. When she joined him, he lifted the ladder and let it down on the inside. Two minutes later they were safely on the ground, the ladder folded up and hidden under a prominent bush.

The launch pad was almost deserted at this early hour, only a few technicians performing some last-minute operations. The Big Bird was sitting silently on its stand; liftoff was at 11:37. Jodie and Keith Sanderson were wearing the standard technician's white coveralls, and it was unlikely they would be challenged once safely inside.

They took the elevator up to the White Room on the top of the Swing Arm leading from the Launch Tower to the vehicle, seeing no one along the way. A short, stout woman with her hair tucked under a white cap was working on a TV camera mounted to face the door. She looked curiously at them, particularly at Jodie's unconfined red hair, but made no comment when Sanderson confidently led the way through the little room and on through a cramped air lock into the pilot's compartment. Jodie realized she should have tucked her red wig under a net. It was the only part of her Sarcoma costume she had been able to wear.

Once they were out of hearing Jodie asked, "Won't she report us?"

"Not likely. She's just here to repair that camera. She'll think we left after she did."

Sanderson knelt at the left rear of the pilot's console and undid the fasteners on a plate in the wall. When it came off, Jodie saw a cabletray loaded with thick black wires. At the rear of the com-

partment the cables and tray exited through airtight grommets, all carefully sealed with bolted guards.

Jodie turned to face the pilot's console, knelt, and worked her way in backward on top of the tray. When she lay flat against the sidewall there was just room enough left for Sanderson. He joined her, then attached a large magnet with a handgrip to the steel plate and lifted it into position. She held a handlight for him, and he sealed it around the edges with a strap of adhesive.

"We'll have to be quiet when the pilot enters, but till then we can talk in whispers," Sanderson said in a low voice. "And it may get a little stuffy, but as I said last night, we should get enough oxygen through the adjoining cable cutouts. Now we have to hope no one notices those bare bolts on the outside of the plate."

They were crowded uncomfortably close together. There was no way to separate their bodies when both lay on their stomachs. Jodie turned on her right side, facing Sanderson, and managed to obtain a few centimeters of welcome space. He was a reasonably attractive man, but she disliked forced physical contact with anyone, male or female.

"This is going to be a hell of an uncomfortable seven hours," Jodie whispered.

"There's no help for it. Why don't you go to sleep, if you can. You must be out on your feet, after flying in from Geneva yesterday afternoon."

"I *am* tired," Jodie admitted. She had been on the go almost constantly in Switzerland, trying hard to work up a successful demonstration. The actual performance had been a dismal flop, and WorldGov officials had apparently ignored them. The whole world seemed to have been intrigued by the dramatic way God Hentson had captured the probe, and the fact he had successfully taken it around the Sun and was again approaching Earth. Even the strongest supporters of FOE in Geneva had been apathetic, apparently certain they had no chance of convincing the world the probe should be released.

Despite the hardness of the cables, Jodie did doze off. She awoke several hours later, to find Keith Sanderson peacefully asleep beside her. She placed an ear against the entrance panel; all was silent inside the pilot's compartment. It was almost nine o'clock by her luminous watch dial. She felt uncomfortable, but not so much that she could not sleep again. When she awoke the next time it was to feel a hand over her mouth, and Sanderson's face at her ear. "S-h-h-h! The pilot is inside, and we'll be lifting off in thirty minutes."

Somehow the time passed, and eventually the muted thunder of a giant engine filled the little compartment with a vibrating rumble

of sound. When the big vehicle lifted off it felt to Jodie as if the entire monstrous thing was falling apart. She could not help remembering this was a cheaply made rocket, designed to be discharged after use. A Big Bird was guided back into the atmosphere after unloading its cargo at the Space Station, the burned remnants falling into some deserted part of an ocean. The pilot returned on the next Earth-bound Space Shuttle, which could land like an airplane.

It was twelve minutes before the sound of a rocket firing suddenly ceased. Sanderson immediately began pulling the tape off the hatch. When it was clear, he seized the grip on his magnet and eased the plate forward and off the bolts. He held it with one hand and pulled himself easily out with the other. Sanderson had been in space twice before, on trips to the Space Station.

Jodie followed the young engineer. It was easy to pull yourself along flat, but she bumped the edge of the wall with one hip, hurting herself. She straightened up outside, clinging to the nearest solid projection and forcing her feet to the floor. The pilot had turned in his chair and was watching in amazement, having just looked that way and spotted Sanderson.

The pilot began speaking rapidly into his spacesuit microphone. Jodie unzipped one coverall pocket and drew her small pistol. She pointed it at the pilot, and gestured for him to be silent. She saw his lips stop moving; he had already reported their presence. She waved the gun and said aloud, "Take off the helmet, mister."

For short missions such as this the pilot normally remained suited, although his compartment was filled with air. Slowly he lifted his hands and obeyed. Sanderson moved to assist him, and a minute later the helmet came off and was stuffed into a drawer.

"Just who the hell are you, and what do you think you're doing?" the pilot demanded the instant they could hear him.

Jodie smiled sweetly at him. "Just call me Sarcoma. My friend is Ken. And what we are doing is very simple. We are going to meet the probe, get Jarl Hentson off, and send it on its merry way. You are going to help us."

"The hell I am!"

Jodie lifted the gun and took careful aim. "You are going to do as we say, or I'll shoot you here and now. Ken can operate this rocket, if he has to. You are highly expendable, mister. Either you give me your word you'll cooperate, and we all make it back to the Space Station—or I kill you and we try it on our own. Which is it to be?"

The pilot gave her a long, level look, obviously trying to see if she was bluffing. Jodie waited, the gun never wavering. Then the astronaut

saw the flight controller on his small screen, who was frantically gesturing, and absently reached to flip a switch on his console. Jodie almost pulled the trigger before she realized what he was doing.

"Denbow! What do those people want? Let us talk to them!"

"Turn him off," Jodie ordered.

Denbow looked at her again, decided she was not bluffing, and turned the viewscreen completely off.

"I have a program already worked out for the intercept," Sanderson said, producing a disk from his pocket. "I'm no astronaut, but I can handle the local maneuvering for the actual contact. We'll make it, with or without you."

Denbow shrugged, and turned back to his console. "OK, you've convinced me. But I still think you're crazy. You'll just smash us into the probe."

"This flight plan was carefully worked out. We have enough propellants on board to go about four million klicks out, turn around, and match velocities with the probe as it comes in. After we get God Hentson off, we'll disable its engines. It will miss Earth by a considerable margin, while we decelerate to rendezvous with Earth and the Space Station."

"And there isn't another rocket on Earth capable of catching the probe," Jodie added. "The next Big Bird can't fly in less than a week."

"So you actually think you can deprive Earth of the probe, eh? Oh yeah, I remember you. I saw you on the Tri-D when you led that bunch of nuts who tried to stop the launch. Well, you didn't succeed then and you won't now!"

"Suppose you just feed the new program into the flight computer and let us worry about that," said Sanderson, his voice trying hard to be tough and mean; it didn't succeed. But Denbow glanced at Jodie, shrugged, and did as he was told.

Chapter 14

Monday, June 22, 2011

"That is absolutely incredible!" said Harold Hentson.

Pat Pajick grimaced. "It's true, Hal. Wilson just called me. Somehow two of those FOE fanatics managed to stow away on the monthly supply flight. Our ground controllers got a good look at them before the screen went blank. The woman was the red-haired witch who calls herself Sarcoma."

Harold's visicon trilled. "What is it?" he asked the gray-haired secretary on his screen.

"Hal, we just got a weirdo call, someone who wouldn't identify herself. She said Alfred Murray will be on WWN any minute now with something you should hear."

"OK, thanks Marge. We'll tune him in."

Harold elevated his desk Tri-D screen and activated the news channel. Two minutes later they

were listening to the sonorous voice of Alfred Murray, reading from a statement supplied to WWN by Sarcoma. It was a declaration of intent to intercept the probe, illegally seized in deep space by the Rockets International Corporation, remove the mentally retarded son of RI president Hal Hentson, and return him safely to Earth. The probe would be left with enough velocity to take it on out of the Solar System. Mankind would be saved from another unconscionable attempt by the aerospace lobby to pour more WorldGov billions into useless and unneeded space technology.

"Who let those two get on board the rocket?" Harold demanded when the newscast ended.

"No one knows, Hal. The guard on the monitor screens last night saw nothing unusual. A technician working in the White Room saw them enter, but she had no way of knowing they were unauthorized. The man with Sarcoma has to be one of our people, someone with access to the flight plans. I'll have security get a description from the controllers and track him down."

"Good. And when this is over, Pat, we're going to have a little house-cleaning at RI. I want security checks run on all our people in launch operations, from the janitors to the VPs. Anyone who belongs to one of the organizations opposing the space program is due for a transfer. We won't fire a person for association-by-conviction off the job—that would be illegal anyway—but we can get them out of the sensitive positions."

"We can try," said Pat.

"Damn it, I feel so *helpless!* Isn't there anything whatever we can do? What does Raoul Stone say about the possibility of taking charge with ground controls? Can we turn them around from here?"

"Wilson says no chance. That vehicle is controlled entirely by its self-contained flight program. And somehow they made up a new one that gave them the trajectory they wanted. Probably used our equipment to do it—and on company time."

"Then I guess we sit and wait," said Harold, the unusual feeling of helplessness growing stronger. He had felt this way in jail, for the three days it had taken Fred Buck to get him released.

The confinement had been a strange, unnerving experience, far worse than the single day Harold had spent locked in the FOE prison apartment. There he had felt in charge of his own fate, had been fighting his own battle. In the Federal jail he had had no choice but to depend on Fred Buck and his staff. The thought that he might conceivably spend months behind bars had deeply troubled Harold, left him worried and sleepless at night. Again and again he had retraced the steps that had gotten him there, considering and analyz-

ing the paths he had not taken. And in the end he could see no other way. His decision to intercept the probe had been the right one. Pressing the launch sequencer switch himself had been the only way to clear innocent RI employees of possible contempt charges. That his act had made him seem deliberately contemptuous of the judge was his personal burden.

Harold had gone behind bars expecting to be out before dark. Instead, the judge had sentenced him to a month in jail, suspended except for three days. Only Jarl's success in space had kept Harold from serving a year. And now that triumph could be ruined by two fanatics who were risking their lives to stop the probe.

Two fanatics . . . as he and his RI associates were also fanatics, on the opposite side. Harold was convinced of the rightness of his cause, but so were the FOE people and their allies. Somehow there had to be a meeting of minds, a better understanding of what was actually best for humanity. The fine work the environmentalists had performed in cleaning the nation's air and streams should not be lost in mindless attacks against all science and technology.

"Hal, the two hijackers still have to deal with Jarl Hentson," Pat Pajick reminded him. "He won't be an easy man to stop."

But Jarl felt that he had been almost stopped already. He was having severe difficulty retaining his mental faculties well enough to operate the probe.

It was a peculiar, disagreeable sensation. He would be studying one of the historical pictorial records when his mind would start to drift. Sometimes it was memories of childhood, obviously his own. On other occasions he saw dim, cloudy pictures of objects he could not identify. Sometimes there were memories of toys he had never had, and places he had never been. Often Lily's face swam before his eyes, frequently that of Hal, and somewhat more often, that of Robert Brown. Feelings came with each face, one of warmth and love for Lily, of love mingled with wariness for Hal, of placid acceptance with Robert.

He would arouse from such gently intruding reveries to find a large portion of some recording had passed unnoticed, and was forgotten. Then for a moment he would be himself again, and would realize his grasp of external reality was rapidly fading. Internally, there was no clear distinction between his mind and that of young Jarl, no fight for consciousness or control. In a way beyond his understanding, some characteristics of both were melding, blending, becoming one.

Jarl wondered what the final result would be.

In the meantime he had little to do but wait. The probe's engines

were firing, and would continue to do so until it entered a highly elliptical Earth orbit. He could already see his home world, a small blue ball in the distance, one growing slowly but steadily larger. His only remaining vital task was to cut off the probe's engines at the right time. As best he could judge by vision alone, the probe was on the flight path selected for it. In two more days he would be home.

Or at least what was left of him would.

Regardless, they had saved the probe. Assuming he retained enough sense to press the right rod at the right time, the probe and all its marvelous knowledge belonged to Mankind. Wild-Hair Harold had been right after all, and when it counted most. And what a prize this visitor was! Jarl had spent many hours studying the extensive visual records, there being little else to do, and grew more impressed with each new showing. Early in the program a friendly gnome had presented an intricate diagram of star positions, one that would obviously tell an astronomer the home location; it meant little to Jarl. There was a simplified diagram of what was apparently a hyperfine transition between parallel and anti-parallel proton and electron spins of the hydrogen atom. He saw a tiny flash of radiation emerge. Jarl felt certain the wavelength would be 21 centimeters, the most likely 'universal signal.' So 1,420 Megahertz was the frequency on which to try interstellar communications, as had long been suspected. The gnomes had not only shown the location of their home, but indicated the frequency on which they would be listening for calls.

There was more, so incredibly much more. Earth's best brains would be busy for years trying to understand it. And the waiting treasures were not restricted to physicists, or even engineers and other technologists. There was a wealth of data in historical records, plus a possible quantum jump in Man's knowledge of intelligence and its manifestations—the latter made possible through the study of a completely alien species and its society. New patterns of thought would emerge, different and original concepts. Even—Jarl laughed aloud, though there was no one to hear—new religious beliefs, an altered perspective on Man's place in the larger universe. The easily impressionable people who had tried to stop the launch might, a few years from now, be in the forefront of some new movement, dedicated to ceremonies worshipful of the all-wise aliens.

Jarl laughed again, and dozed off where he sat, and awoke some time later with his mind dim and his perceptions confused. Mama had been gone for a long time. He wished Hal would come in to see him. Without actually formulating

the thought in words, he wondered if Robert loved him. At times he seemed to, but at others he was distant and remote, playing games and talking while his mind was obviously elsewhere. He wondered why Robert didn't love him as much as Mama and Hal did.

Tuesday, June 28, 2011

"There it is," said Denbow.

Jodie looked through the forward window. She saw a silvery ovoid, tiny at this distance, suspended on a larger cloud of blue fire. The Big Bird had been firing steadily for over seven hours, and despite the fact she had spent more time in the co-pilot's chair than Sanderson, she was bone-deep tired. The times the extra person had to sit flat on the floor with legs extended were the worst.

On the trip out, Sanderson had thoughtfully built two rest periods into the flight plan. This long return burn, to counteract the velocity they had acquired and match the forward speed of the probe, was an unrelieved grind. But now the target was in sight, and they still had more than enough propellants to decelerate and enter Earth orbit.

Denbow turned off the main drive and started closing by sight, using the maneuvering engines. Their velocity barely exceeded that of the probe. Since the other spaceship was still decelerating, he could hold the Big Bird in front of the probe and the two would eventually meet—but it was faster to use power.

"What makes you think Jarl Hentson will let you inside?" Denbow asked Jodie, as the probe seemed to drift down and closer in their sight.

"He's been out of touch since he closed that round hatch in the nose. I'm sure he'll think Sanderson is an astronaut, sent up here to tell him something he has to know. Why else would RI waste another Big Bird? We're hoping he'll turn off the engines, to make the contact easier. Since he'll have to put his spacesuit back on before he can open the hatch, all we should have to do is force him to transfer over here. The probe will then miss Earth by a half-million kilometers, and keep on going right out of the Solar System."

"Did you think we came this far without working it out?" asked Sanderson, his voice somewhat squeaky over the radio. He was dressed in a spacesuit, with his radio jack plugged into the ship's intercom.

"It wouldn't have surprised me a bit," said Denbow, obvious contempt in his voice.

"I'm a guidance engineer, mister. I helped write the program you started with, and did the one that got us here by myself. We know what we're doing."

"I doubt that," said Denbow. He glanced at Jodie, who was standing

with her feet braced against the floor, her back to the frame of the air lock. There was less than one G holding her in position. She had traveled extensively, but this was her first venture into space. And while she had not experienced the stomach cramps or indigestion that bothered many first-time travelers, she had suffered badly from a sense of disorientation. At the moment her weight said the vertical bulkhead was the floor, while her eyes said otherwise. So far, she had managed adequately by ignoring the pull of acceleration and keeping her body physically upright in relation to the floor.

Jodie was still holding her pistol. She or Sanderson had kept Denbow under constant watch since they emerged from hiding. So far he had had the good sense not to try anything foolish.

"You'd better hope we know, Denbow," Jodie said, making her voice cold and hard. "We're a bunch of nutty fanatics, remember? If we can't get Jarl Hentson off and return to Earth, we might just ram into the probe and destroy both vehicles."

Denbow looked down at his console. "The thought that you would is why I've gone along so far. I could never see myself as a martyr."

"Then you aren't an entirely hopeless case. Come to the next Orlando FOE meeting after we get back. You'll be our first astronaut member."

Denbow was silent. They were now almost on the same flight path as the probe, and moving rapidly closer. When they were within a few thousand meters, the great blue cloud behind it abruptly flickered out.

"See! We told you!" Jodie cried aloud in delight. "God Hentson shut his engines down. What do you want to bet he'll let Sanderson inside? It's all over but the shouting!"

Denbow abruptly cut his own power. They were now rapidly closing the gap; he had to put his maneuvering engines on full reverse thrust. Within minutes they were approaching the silver nose. They stopped, in relation to the probe, only meters away.

Jodie saw that Denbow was sweating slightly, and his face was pink. She had a sinking feeling a disaster had narrowly been averted, that if it had been Sanderson at the console their mission would have ended seconds later when they smashed into the shining metal egg.

Which might have accomplished the objective, but was hardly what Jodie wanted. Like the astronaut, she had no desire to be a martyr. This interception was Keith Sanderson's idea. If she had not believed him when he said it could be done safely, she would not have come along.

As it was, they would undoubt-

edly be captured, and her true identity as Judy Karlson exposed. She might even have to go to prison for commandeering the Big Bird. The attorney in the Orlando FOE chapter had assured her there was little SB could do to them for detouring the probe. There was no registered legal owner to file a complaint.

"Are you ready?" Jodie asked Sanderson. The bearded young engineer nodded, and unstrapped himself from the co-pilot's chair. He attempted to rise, and floundered helplessly for a moment before regaining his equilibrium. Jodie was still braced against the bulkhead, and in control of her movements. She watched Denbow while Sanderson was momentarily helpless, but the astronaut made no hostile move.

Sanderson got himself oriented and pushed off toward the tiny air lock. He managed to get inside without further problems, and closed the inner hatch.

"Denbow, I want you to know—I want you to *believe!*—that I will shoot if you try anything that could get him hurt. I don't know what you're doing there—but if Sanderson doesn't appear in front of us in just a few minutes, alive and well, you will be very sorry."

Denbow gave Jodie another of those disconcertingly long straight looks, and did not answer. Instead he turned back to his console, and operated several switches. Over his shoulder Jodie saw the needles on several gauges move in response, but she could not read the lettering on them and it meant nothing to her.

There was a metallic clanging sound from the air lock, one conveyed by steel to the air in the cabin. A moment later Jodie saw Sanderson through the side window. He waved, and continued on past the vehicle toward the probe. He was holding a portable propulsion unit in one hand, guiding himself by positioning it in relation to his body. As she watched, he got it out of alignment with his center of gravity and went into a slow spin.

Sanderson immediately cut power, and straightened his body. He continued to slowly revolve as he moved through space, but he was still headed for the probe. He hit it somewhat harder than planned, and started to bounce away. Fortunately, his feet were toward the silvery skin, and he managed to swing them down and make contact. The magnetic shoes locked him in place, and he straightened up. His arms were swinging wildly in an effort to stop his involuntary body revolution; he lost the hand propulsion unit. Jodie saw it drifting away into space.

She heard a sound behind her, and realized she had been watching Sanderson too long. Jodie swung both her head and body, the left hand gripping a protruding pipe for balance, the right bringing up

the little pistol. Denbow was already in the air toward her, face set in a strained expression, hands reaching to knock the gun away.

Jodie had time to think that the choice was stark and simple. Shoot, and face a possible murder charge from which not even her father could save her—or let him reach her and know the struggle was over, and she had lost. There was no way she could fight this man in the environment for which only he had been trained.

Jodie pulled the trigger.

Jarl waited until he heard the astronaut actually tapping on the nose, then depressed the rod that extended the central shaft and hatch. He had struggled into his spacesuit—an awkward job without help—when the Big Bird started its final approach.

Whatever the reason for this unexpected meeting, it had better be good. When he had realized he would have to exhaust all his breathing air, he had examined his bottled supply. As best Jarl could tell, there was enough to refill the compartment one more time. It had been growing somewhat foul, and he had been thinking it was again time to dump part of it and release some more fresh oxygen. But having to pressurize from zero once more would leave him little safety margin.

It occurred to Jarl that perhaps this was the reason for the unplanned interception. Someone could have miscalculated, and figured he was too short of oxygen to make it without help. If so, it seemed odd the astronaut had not brought a bottle with him. They knew Jarl had entered with plenty of food and water. But if they were not bringing him oxygen, what in the world could have justified losing the small fortune represented by that Big Bird outside?

Although pressure in the probe was low, it was still enough to send the air rushing out with respectable speed. Jarl stopped the hatch with it barely cracked, afraid the stream might hit the man and blow him away. And he again tried his radio, as he had several times already. Evidently his batteries were weak, though they should not have been. There was certainly no reason for the astronaut not to answer.

When the air was gone, Jarl opened the hatch the rest of the way. A moment later a helmeted head slid into view from above. Through the faceplate Jarl saw the man wore a heavy black beard—most unusual for an astronaut. The man crawled the rest of the way inside, then straightened up. He saw the shaft with the handgrips, and clamped his legs around it. As Jarl watched, the astronaut zipped open a pocket on his leg—and withdrew a gun.

"Mr. Hentson, I'm very sorry, but you will have to come with me. Please don't offer any resistance. I

will shoot if I must."

For a moment Jarl thought with stunned wonder he was back in the dreamworld that had haunted him so much lately. This had to be a figment of his imagination, some childish drama that had impressed itself on the memory of his grandson. He had been aroused from lethargy and a half-dreaming condition over an hour ago, when he first spotted the approaching spaceship. Somehow the adrenaline generated by excitement had revived his grip on reality, bringing back all his faculties; or so he had thought.

No, this was real. Jarl shook off the feeling of uncertainty and tongued his mike on. "What in the world is this? Who are you, and why are you here? And why did you refuse to answer, if you could hear me calling you!"

The bearded man smiled. "I declined to talk with you because we didn't have a good cover story prepared, Mr. Hentson. That's one of the several details we overlooked. But silence worked just as well. Now I am going to move to one side, and you are to pass me and exit out the hatch. Don't touch any of the controls. I want those engines left off."

"But—but *why?* What could you

possibly gain? And why do you want to deprive Earth of the probe?"

"That's a long story, Mr. Hentson. Let's just say I belong to a different school of thought. I've tried both sides, and decided the one for which I was formally educated is heading in the wrong direction. But we can discuss philosophy on the way back home. Now come ahead, please. And if you want your grandson's body back on Earth safe and well, don't force me to put a bullet through it."

"You seem to be in charge," said Jarl. He moved to the central shaft and started slowly pulling himself along it. The bearded man released his grip and moved a safe distance away, waiting for Jarl to pass.

At the hatch Jarl turned over, and pulled himself out and up with his back to the shaft. He had seen the other man following behind him. Outside, Jarl clamped his shoes to the rounded wall and took four fast steps around the circumference of the opening. He had guessed correctly. His captor emerged from the bottom, moving quickly. He wanted to be in the open and away from Jarl before he could be reached. The gun was still held in one gloved hand.

Jarl felt his heart pounding hard. He was in complete possession of his mind, the excitement and stimulation having overcome the tendency toward troublesome intrusions from the memories of his grandson.

The second man came out with his stomach toward the shaft, expecting to find his captive in sight on the opposite side. Instead, Jarl was behind him. He chopped hard at the wrist behind the gun, and connected. The weapon spun away. The man made a frantic grab for it with his other hand, missed, flailed wildly with his foot, seeking a grip—and hit the extended hatch. The impact threw him into a spin and a slow drift away from the opening, his body revolving rapidly around its own center of gravity. And he was moving directly away from the two spaceships.

"Help! I can't stop! I'm—"

Jarl started to launch himself after the other man, then hesitated. Neither of these suits had a self-contained propulsive system. Unless there was an alert pilot on the Big Bird, they could both drift away and never be found.

"Listen to me! Listen!" Jarl almost yelled into his mike. "Take off your left glove! Quickly now, take it off! Scrape the inner hand seal against your urine outlet until you have a leak! Hurry, you can do it! Stop your spin, and then you can straighten your body and use the leak like a jet to push you back here. Control the flow by pinching it off with your right hand."

"I—I can't!" a helpless wail came back. "I'm trying but the glove won't come off! I—how do you do

this with one hand? *Help me!*"

Jarl started to rip his own glove off, but stopped again. The procedure he had just given was not included in any handbook; it had emerged strictly from rugged experience. The younger man—who was obviously no astronaut—seemed incapable of putting it into effect. But the air supply in Jarl's tanks was very low. He would be lucky to even reach the slowly receding figure, much less get back.

"I can't come after you! No air! Now do as I said! Get that glove off and scrape a hole. Hurry, before you get dizzy."

"I'm . . . already dizzy! I'm trying, but I can't—"

"Hello in the Big Bird! Can you hear me?" There had not been a single response from the other vehicle, but Jarl had to try. "A lost man is drifting out of control, almost directly away from the Sun. Can you go after him? Over."

But there was no answer. For all Jarl could tell, the bearded man might have been on board the other ship alone.

Chapter 15

Tuesday, June 28, 2011

Jodie was not alone, but Denbow was unconscious. The bullet had grazed his skull, plowing a shallow furrow across the bone. She had been shooting at his head, and almost missed the moving target. The lead slug had gone on past him and smashed into the pilot's console. By some unlucky freak of chance it had hit a main power supply, and created a terrible short circuit. The cabinet had sputtered, several arcs had flashed—and the lights went out. When they came on again only certain widely scattered bulbs were burning, obviously from batteries.

By ripping her coverall to pieces, Jodie managed to fashion rough but serviceable bandages. She packed the bloody crease with cloth, then tied rags around his head. The material soaked through with blood, but then the flow seemed to stop. Denbow remained unconscious; his breathing was loud and ragged.

Jodie had seen wounded people before, at more than one demonstration. Denbow was suffering from shock. If he was kept warm and left alone for a few hours he would probably survive.

The air in the little compartment was foul with smoke, but the emergency fans were slowly clearing it away. When she was convinced Denbow would live, Jodie left him long enough to examine the console. You did not have to be an engineer to see the damage was extensive. If this was the only system on board capable of controlling the spaceship, it would never move under its own power again.

Jodie had tried to watch Sanderson as he went after Jarl. She had seen the brief fight outside the probe's hatch, and watched the

young engineer slowly revolve away into space. Somehow she sensed when Jarl was trying to call the Big Bird on his radio, and looked helplessly at the console. There was probably a separate emergency communications system somewhere, but she did not know how to operate it. She went to the front window and tried to signal to him, but the angle of light on the glass outside was wrong, and he could not see her.

There was nothing she could do but try to keep Denbow warm, and wait until God Hentson decided on his next move.

That didn't take long. She watched the spacesuited figure launch itself from the probe's silver nose and drift directly toward her, feet first. As he came closer she saw that for some reason he had taken off his left glove. His aim was good. She watched him land on the nose just below the window. She heard his footsteps as he walked around the hull and out of sight.

It was less than five minutes later before the inner hatch opened, and God Hentson floated smoothly inside.

The emergency environmental control system had almost cleared the room of smoke. The suited figure quickly closed and tightened the inner door, reached to his helmet, released the catches—and Jodie was face to face with a dead man born again, the fabulous Jarl Hentson.

She was looking at a grown but very young man, one with a fuzz of blond hair starting above his mouth, the ragged beginning of a beard. She had heard, but even in seeing she could not believe. This was Jarl Hentson resurrected, the God of technocrats and engineers come again, the father of Jesus Hentson, and perhaps the most recently famous man in the world. It was incredible that this could be him.

And then Jarl smiled, an ironic twist of young lips, and said, "I recognize you. You were one of the leaders of that attempt to stop the launch, the girl who wore scarlet."

And suddenly it was all believable, and very real. The voice was resonant and strong, from deep in the chest, the practiced tones of an orator. The gaze was sharp and direct. Somehow he seemed to be *concentrating* on her, giving her his undivided attention, as though they were in a room full of other people whom he was presently ignoring. And she recognized this ability of intense concentration as an attribute few people had. Most of her associates could not keep their minds on one subject for two minutes straight.

There was something overpowering in this boy/man's presence, a built-in expectation of command that exceeded mere arrogance. Harold Hentson had the

same quality, to a lesser extent. They were men so absolutely sure of themselves they could afford to be democratic, without pretense or condescension. It was the indefinable quality of leadership.

"Yes, I am the 'scarlet woman,' " Jodie said slowly. "My name is . . . Sarcoma." She saw his eyebrows raise, and a quick grin come and go. "But we can get acquainted later. Right now I want to know what happened to Sanderson. I saw him drifting out of sight. Can we go after him?"

Jarl moved easily to the pilot's console, and strapped himself in the seat. He examined the burned and blackened surface, then removed an access plate and peered inside. He straightened in the chair, shaking his head. "That's a hopeless mess. And these cargo and propellant boosters are cheaply made, without an auxiliary control system. They were intended for one-time use."

"Then can't we go after him using the probe? I know you can guide it, and stop and start the engines."

"I'm afraid not. The probe was designed for long-distance navigation, where every course change has to be planned days or even weeks in advance. It isn't very maneuverable."

Jodie was silent. She remembered that only hours earlier she and Sanderson had lain cramped in the narrow cable compartment, and she had turned on her side to keep from touching him. Now she wondered why.

"I lost contact with him when I came inside," Jarl went on. "Let's try to reach him on the emergency comm system."

He released himself from the chair and pushed off to a bulkhead on the left, where a square black box mingled with the rest of the equipment. When he opened the cover Jodie saw a small headset. Jarl slipped it on, flipped two switches in the bottom of the box, and spoke into the tiny mike. He tried several times, before slowly removing the headset and replacing it.

"He doesn't answer. And this system is working, so the problem is on the other end. He's probably unconscious. I'm sorry—but I don't think there's anything we can do."

Jodie felt the taste of bile in her throat. She had seen hurt protesters, wearing their own blood like badges of honor—but this was the first time anyone had died under her leadership.

Jarl had moved to Denbow and was examining him. The wounded man's color had improved, and he was breathing easily. Jarl checked his spacesuit carefully, apparently to see if the bullet had hit it also. The suit appeared undamaged.

"Let's get his helmet on and look for another hand maneuvering unit. And I've got to transfer your gaseous oxygen tanks. With three of

us in the probe, the present supply won't last even the two days left to Earth."

Jodie was jerked back into an awareness of the present. As was customary with Hentsons, this man was taking charge. But she hadn't come this far and risked this much just to accept defeat tamely. She drew the small pistol from the jumpsuit's side pocket and said, "But we aren't going to the probe, Mr. President. Those engines stay off. We're going home in *this* ship!"

Jarl looked at the gun, then raised his gaze to her face. "That's impossible. It would take a crew of techs to replace that console and recheck the power supply. We go home in the probe, or not at all."

Jodie was holding the pistol loosely, the muzzle pointed at Jarl's feet. The boyish but muscular figure straightened, moving toward her. She lifted the gun in warning, and he stopped two meters away.

"Somehow you don't seem the type who would commit suicide," Jarl said, looking directly into her eyes. "You made a good try at stopping the launch, and would have succeeded if Harold hadn't scared your friends away. But out here the choice is different. Either you put down that gun, and help me transfer this man and some oxygen to the probe—or we all stay, and we all die."

"But if I don't, the probe will go on past Earth. And millions of hungry people will know what I did, and FOE did, and be grateful. The money that would have gone into analyzing this silver monster will be spent on food, and shelter, and medicine, the things people really need. I can't deprive them of that by letting you take it back."

Jarl was still staring intently at her, and Jodie felt her resolution stiffen. He saw the change in her face and smiled, an expression that seemed somehow sad and aged, out of place on that young face.

"Sarcoma, as you call yourself . . . are you so convinced of your rightness that you'd die for this cause? Can't you tell yourself that once back on Earth you could still work against the probe? That you could pressure WorldGov to hold spending on it to a minimum each year? Why do you have to adopt an either/or attitude? Life isn't that simple, and certainly human society isn't. Why sacrifice yourself when it isn't really necessary? You could achieve the same ends just as well alive."

The proposal was alluringly attractive, logical enough to be almost believable—and ultimately, false. If this thing ahead of them got back to Earth, in twenty years Man would be sending copies of it to the stars. Jodie did not believe what she had heard about radio communications, and an exchange of knowledge across the depths of space. That would put too few people to work, and too little

money in the pockets of space contractors and their Government collaborators.

Jodie remembered a bitter lesson she had learned in college, from a teacher who was a founder of FOE. It was the answer to a simple question, one he had posed to the class. "What was the *real* purpose of the tremendous expenditures by the US Government in the 1950's and '60's in the field of public housing?" The answers had ranged from the standard humanitarian considerations to an effort to defuse a budding revolution. The teacher had smilingly listened to them, and said, "No, those were secondary reasons. The *main* drive behind public housing was the desire of a lot of contractors to make money *building* it! The actual *use* of the housing was not important, at least not to anyone with political power. And we all know the result—instant slums, to be torn down in a few years when they began crumbling around the tenants' heads. When Government money is dispensed, *somebody* always makes a profit."

And so it would be with the probe. The aerospace industry would benefit at the expense of the rest of the world, and Jesus Hentson would grow even richer and more powerful. Perhaps he too would make President some day—or WorldGov Premier, now that the higher office existed.

"Sorry, but I don't believe you," Jodie said, keeping the gun pointed at his broad chest. "This game is going to be lost or won right here. And I think you've lost."

"It isn't a game. Perhaps that's the difference between us: you think it is. But you're right that it must be settled here. Do you know what I really am? A persona imposed on the brain of a hopelessly retarded grandson?"

Jodie nodded.

"But you probably don't know that I'm already slowly dying. That's right, the grip I have on this brain is starting to fade. I give myself maybe three more days, and then I'll lose control. The body's original mind is still there, but it never reached much above the idiot level. Young Jarl's mother would miss him, and his father—but if someone has to die . . . Hal wanted to try it himself. Since he wasn't qualified he sent the two Jarls. We're highly expendable."

"What are you getting at?" Jodie asked sharply.

"Just this. If you're going to kill us all, you may as well do it now. Shoot me, and kill the pilot there while he's still out, as an act of mercy. Then put a bullet through your own brain. Don't put the barrel to your temple, that's the amateur's way. It might not be fatal with such a small caliber. Hold the barrel in your mouth, just behind the edge of the front palate, and shoot straight up."

Jodie shuddered. His description, and the thought, were more repul-

sive than the act itself would be.

"No thanks. Let's just wait until the air gives out, and go quietly."

"Sorry, I won't allow you that. You are either going to have to shoot, or give me the gun. Now I am going to pull myself to you along this wall. If I reach you, I am going to take the pistol. Then I'll try to save us all. It won't be easy because we're running out of time, and I think we'll be short one spacesuit."

Jarl reached for the wall, caught a projection, and began slowly and calmly pulling himself toward Jodie. She raised the pistol to eye-level, took careful aim at his head—and froze, suspended in time, the confined world of the pilot's compartment sharp and bright and clear around her. There was no hurry. She had subjective hours in which to squeeze the trigger.

And to make up her mind.

God Hentson had gotten to her, after all. She did not want to die. She had managed to shoot the pilot when he jumped her, knowing it might mean prison later—but her own life was not immediately at stake. Now it was. And the hard and pressing question was: Did she believe in her cause strongly enough to die for it?

There was no chance Jarl Hentson would turn back. He was coming toward her with the relentless calmness and certainty of one of the giant machines he represented. This was not a contest of wills between them—his was implacable. It was a test of hers alone. If she believed, she must pull that trigger.

Jodie concentrated on the tension against her finger, the fragile resistance of oiled steel, the tiny bit of added pressure needed—and Jarl slowly and carefully reached for the pistol, and pulled it from her hand.

Jodie let it go, and turned and faced the wall. For the first time since she was twelve years old, she felt like crying . . . but she didn't.

Jarl returned to the probe by the same method he had left it—carefully pointing his body in the right direction and pushing off with his arms. He still had his left glove off just in case, but did not have to create the emergency maneuvering system he had outlined to Sanderson. His aim was again good, and he landed near the hatch.

Jarl untied the end of the electrical wire around his waist, pulled it taut, and secured it to the door shaft. The wire was the heaviest gauge he had been able to rip free. Then he crossed back by it and entered the crippled Big Bird's air lock. Operating the closing mechanism by hand was a nuisance, but he endured it.

Inside, he saw with approval that Jodie—he had refused to continue calling her Sarcoma—had Denbow ready to go. He checked the uncon-

scious man's air supply himself, then told her to start getting into one of the four spacesuits they had found listed in the cargo manifest. That, at least, had been a bit of good luck. That he had thought to check indicated his brain was still in good working order.

The air lock was only intended for one person at a time, but Jarl managed to squeeze in with Denbow. Pulling the limp body of the pilot along the wire was tricky, but the trip was short. When Denbow was safely inside, Jarl hurried back. He was in time to help Jodie on with her helmet, and verify that the attached back-pack had plenty of oxygen.

So did the other three tanks, which Jarl had separated from the packs. Why they had been shipped pressurized, when they could as well have been sent empty and filled from the Space Station's liquid oxygen conversion unit, was a question to take up later with the RI Safety Office. For now, they were the only supply of easily transportable oxygen on board the Big Bird. Jarl did not have the equipment needed to remove liquid oxygen from the propellant tank, or free and transfer the large bottles supplying the pilot's compartment.

"How long do we have before you need to start decelerating the probe again?" Jodie asked over the radio as she followed him outside. Now that she was committed to living, Jodie seemed as anxious about her prospects as anyone else.

"I don't know exactly. This is seat-of-the-pants navigation. I'd have tried to get some updates from Earth if you hadn't ruined the radio. The emergency comm system won't reach that far. Now when you grasp the wire, pull very gently, and remember you'll keep moving once you've started. Don't build up much speed."

Jodie did as she was told, and reached the probe safely. She hesitated before crawling into the narrow opening behind the round door, but made it inside.

Jarl waited at the air lock until Jodie vanished, then started across. He had the three tanks clasped under one arm, a bulky but not difficult load. But he miscalculated his momentum because of the extra mass, and his feet slammed against the round hatch harder than he had intended. The jar was not enough to cost him his grip on the precious oxygen.

With his cargo safely inside, Jarl untied the heavy wire. He was outside the probe, with his bent knees locked over the door's edge. He formed a loop in the heavy line as far out as he could reach, gripped it in both hands, and pulled with all his might. Nothing happened. He kept up the pressure for two minutes, every muscle in his strong young body trembling with effort—and very slowly and gradually the pressure eased as the line moved,

slipping almost imperceptibly toward him.

Jarl cast the line away, toward the Big Bird, and hurried inside and down the shaft. At the peculiar control station he activated the mechanism that pulled the hatch closed, watching the other spaceship through his right outside camera. It was moving toward them with slow but massive inevitability. They were going to bump.

Jarl glanced at Jodie and Denbow. She was crouched over the still unconscious man, watching his face. Earlier she had tried to kill him. Now that he was alive, she was intensely concerned over his health.

And somehow Jarl could not think it was simply because of the difference between a murder charge and one of armed robbery. She was honestly worried about the man she had shot.

"Move back to the rear wall and lay Denbow flat against it," Jarl said over his radio. "This bird doesn't accelerate very fast, but he should be spared all the strain we can save him."

Jodie nodded, and pulled her patient along like a balloon behind her. At the rear she found a clear flat space—the back wall was not as cluttered with equipment and instruments as the others—and grasped a projection to steady herself while she held Sanderson in place with her legs.

Jarl looked back at the screen. The nose of the Big Bird had almost reached them, looming enormous only a few meters ahead of the camera eye. And a minute later there was a solid but subdued bump, and the probe's front started slowly rising. The more pointed nose of the Earth cargo carrier had hit them just below the hatch, as Jarl had calculated. It was angling beneath the round silver belly, and would eventually pass beneath.

But Jarl did not wait. The probe's rockets could conceivably be hit and damaged. When the tilt reached the point where the other ship became lost to the camera, he depressed the engine-start rod.

The probe's engines came alive with blue fury, and there was almost instant gravity inside. The ship sliding beneath them was hit by the exhaust and started a slow spin—Jarl saw it by slanting the rear camera downward to its limit—but it no longer mattered. The probe was gone long before the other ship's tail passed through the space where it had been.

If the probe had small attitude engines like those on the Big Bird, this maneuver would not have been necessary. But as he had told Jodie, the gnomes had designed it for one purpose only, and maneuverability was not needed. In fact he had yet to learn any means of operating the engines other than at full power. But the nozzles could be tilted slightly, which was how the probe guided itself.

Jarl turned off the engines after a few minutes, and hunted with the rear camera until he found Earth. It took him two more sightings to regain his former attitude and make a slight change in the angle of approach. He had to work in the three hours of deceleration they had lost here, performing all calculations in his head. But when the Sun was finally directly ahead and the Earth behind and well to the left of center, he felt satisfied again. This was crude navigation, but he had plenty of time over the next forty-eight hours in which to crank in corrections.

And then he set about opening the valves on the last of his original supply of oxygen, wondering how long it was going to sustain three people, and if it would even reach the minimum pressure needed to assure good breathing.

After an hour passed he knew the oxygen pressure was satisfactory, and felt certain the amount in the back-pack tanks could freshen it enough to keep them alive.

Unless they were going to miss the Earth entirely, a possibility Jarl could not ignore. He refused to let the thought worry him.

Chapter 16

Thursday, June 30, 2011

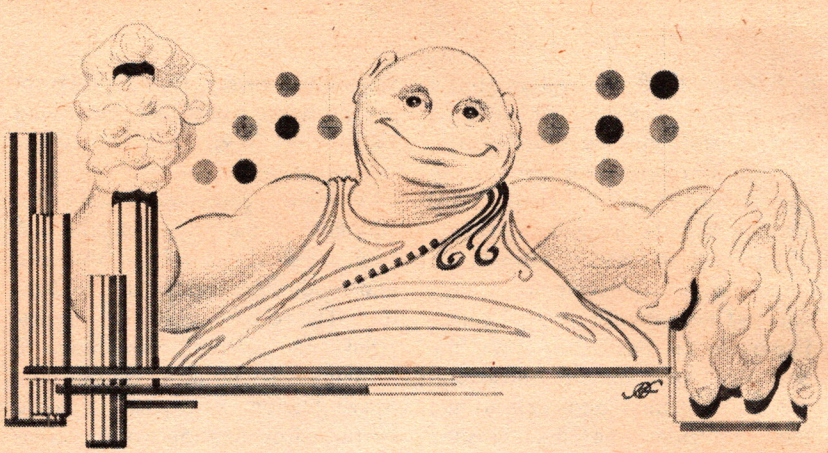
Harold turned away from his desk screen and let it sink out of sight. Along with a large portion of the rest of the world, he had just watched a Space Shuttle intercept the probe at perigee on its second Earth orbit. WWN had carried the event live.

A highly experienced SB pilot was now in the probe, and he had been supplied not only with oxygen and food, but a hastily installed radio. The orbit would be circularized and lowered, preparatory to bringing the probe alongside the Space Station. After that it would be turned over to the world's scientists and engineers for study.

Harold glanced at the court order still lying on his desk, the only piece of paper there. He, specifically, and RI as a corporation, was ordered to hand over custody of the probe to authorized representatives of the Space Benefits Agency. And this time there was no way to fight the Government. Not that he wanted to. The three days he had spent in jail had taught Harold what to fear and dread—confinement and helplessness. He would not willingly go behind bars again.

And of course he had expected all along that WorldGov would take the probe away once it reached Earth. It would have been uncharacteristic of government in general to have behaved otherwise. RI's countersuit was already in court, and the eventual terms of settlement would assure them a continued role of leadership in the aerospace industry.

Harold was more worried over



Jarl. He had seen him give a casual wave to the TV camera, but his son/father had refused to speak to newsmen on the Shuttle. And he had made a strange request of the doctor on board—that he be put to sleep, and not awakened until he was safely back at the RI laboratory where he had been 'treated.'

According to Pepi's best estimates, it was now time for the persona of Jarl Senior to be fading away. The only answer that made sense was that this was happening, and the old man did not want to betray his mental confusion.

Harold had a sudden thought, and reached to punch his visicom button. "Pat, have someone get over to my place and bring Lily here. Tell her we're going to meet Jarl when he arrives."

SB had swiftly agreed to RI's request for custody of Jarl. They did not want to be responsible for him. He was to be under Pepi's care during his recovery.

The landing of the Shuttle and the removal of the three special passengers was not televised. But it was less than two hours from the time Harold had turned off his screen before he left his office to meet the ambulance aircar on the roof. Lily was already up there, patiently waiting.

To Harold's surprise, he saw Jodie Carson get off the aircar with the stretcher holding the sleeping Jarl. The third passenger, Denbow, had been taken to the Space Center medical facility to have his head wound properly treated.

Lily rushed forward, to stand with hands clasped over the unconscious body of her son. She was trying hard to hold back the tears. As the two medical attendants rolled their patient toward the elevator, Jodie following, Harold fell into step beside her. A man he did not know walked behind them.

"I'm under arrest," Jodie said by way of greeting, pointing to the

man following her. "But I convinced the top WorldGov guard-dog at the landing strip I had some medical info on Jarl, so they let me come along."

"Do you?" Harold asked.

"Oh, definitely. For one thing, the persona fades almost completely now when Jarl is sleepy or inactive. Even when he's wide awake, the mind is very shaky unless the body is active or excited. While he was placing us in orbit I had to keep yelling at him, insults and such, to make him angry."

In the lab, Pepi and the company doctor carefully examined Jarl. After talking with Jodie, they decided to awaken him, but without using a stimulant. After a gentle shaking, Jarl sat up in the stretcher and smiled at them. He yawned, hands high over his head, and sighed. He looked at Lily, and in a voice filled with love, said, "Hello, Mommy."

Harold could hardly believe his ears. This was certainly not his father speaking—but neither was it his idiot son!

Lily gasped; the shock was almost too much for her. The tears that had been leaking from her eyes swelled to a flood, and she ran to clasp Jarl in her arms before the medics could stop her. Pepi motioned for them to leave her alone, and Lily buried her face on her son's broad chest.

"As I was saying earlier," Jodie said to Pepi, "Jarl—the imprint, that is—told me he felt the subordinate mind coming back into control, taking over more and more of the body's functions. But he also said the other mind seemed to be stronger now, as though perhaps new neural pathways had been opened. He was having complete, coherent thoughts that were not really his own, and felt they had to be from young Jarl. It was his opinion he would fade away completely after a time, but the mind wouldn't revert back to its original state. Oh, before I forget, he also said he had noticed all along he was receiving his grandson's *emotions*, that any time he thought about Harold, or the boy's mother, he would get strong upwellings of feeling that he knew weren't really his. It was the persona Jarl's hope that the problem with young Jarl's mind, whatever it was, had been cured, and he could lead a normal life now. He said you were to run some basic intelligence tests as soon as the imprint was completely gone, and see if young Jarl's mind didn't seem capable of learning. He felt certain it would be."

"I'm beginning to think so myself!" Pepi said, his voice growing excited. "I wonder—could this imprint technique be modified to cure other cases of retardation, where there's no organic damage? This could open up a whole new field of medicine!"

Harold had to repress the inclination to chuckle aloud. That was

a good RI scientist talking. But it wasn't really their line of business, and Pepi's work would have to be turned over to some organization better capable of developing this fresh start. He wondered if he would lose Pepi when it happened.

"Can I have just a moment alone with this criminal?" Harold asked the security man following Jodie.

The officer shrugged. "Mr. Hentson, I expect you could have just about anything in the world you wanted right now. Just bring her back to me, please."

Looking surprised, Jodie followed Harold into Pepi's office. When they were alone he placed both hands on her shoulders, staring into the dark eyes that met his in wide curiosity. "I was wondering—" Harold hesitated, searching for the words. "What I want to know is, has this adventure changed your feelings toward the space program? Do you still think we're a useless luxury now that you've seen what space science and technology can do? Is it possible for us to be . . . friends?"

Jodie pulled back from him, smiling in wry amusement. "You don't want to be friends, Hal. You want a mistress—and it's a tempting thought, but it wouldn't work. The only place two strong wills like ours could agree would be in bed—and that isn't enough. Of course I'm going to keep fighting the space program. It's no more useful today than it was last year. Maybe less, because now some of the dreamers will start bigger and more wasteful projects to explore the whole galaxy. You and your father have opened up a big new playground for them."

Harold did not try to hide his disappointment. "I should have realized you'd still feel that way. Sorry I asked."

Jodie's expression softened. "Listen, Hal. We had one good night, and that's more than most people get in their lifetimes. Settle for it. Now I have to call my lawyer and try to arrange bail. I've seen the inside of too many jails already. No, don't kiss me. Let's end it clean. The next time you see me it will be across a picket line."

Jodie walked to the door, and out.

"I think the space program has been largely responsible for this surge of interest in ecology—those wonderful photographs of the planet Earth had a tremendous psychological impact. It's no coincidence that we became aware of the ecological crisis at the precise moment when we saw our beautiful green planet hanging over the lifeless Moon. What we need now is not less science or less technology, but *more* of both—but they must be carefully planned."

—Arthur C. Clarke (From remarks made at the Trieste Science-Fiction Film Festival, Trieste, Italy, 1971) ■

DANIEL P. DERN

The revolutions in physics shook the world.
The coming revolutions in biochemistry . . .

LOVE *FOR ALL AND ALL FOR LOVE*

DOUGLAS BEEKMAN

Ssst, that's all, simple as that; and now it's love, love, love, the real swoon-and-moon thing for everybody, simple as that, just aim and spray and there you are, two-hundred percent pure-blooded love, no matter who you are or aren't. After all these years, we've finally done it: ultimate equality of the soul in a can or bottle, tube, spray or roll-on gel. Yes, that's what it is, and you too can have it. *Everybody* can have it. Love, love, love in your choice of flavors, get some quick.

Wouldn't you know, the whole world just plodded along fighting and yelling and generally being unhappy (You think otherwise? Look again.) because to launch out and land some love just was too big an armful for most everybody, and even those who did jump often fell, but this grad student, or maybe he was a postdoc, out at the University of Wisconsin (Or was it Cornell University; you tend to lose track when you don't know it is important until it's too late to get your facts straight, but so much for history.), anyway, he'd been downed and outed by his sophomore sweetheart, and retreated to the library where he decided to read everything there was about love, and pretty soon he found out there wasn't all that much, if you didn't count all the flesh-folly funnies that used to be so popular. He read through Ortega y Gasset, who had said the only obvious stuff about love since Plato (who hadn't said much), unless you count Stendhal, and maybe de Sade, and I suppose de Beauvoir (that's French for "Hi, there, good-looking."), but mostly it boiled down to love being a state of mind a lot like delusions and madnesses and fixations, generally a rather hairy self-induced monomania sustained by an exterior object, usually and preferably another person. So our fair-haired fakir, he was in chem or maybe bio (it's hard to be sure these days), decided to go to his lab and boil it down a little bit further. Ten days later he stood up from his desk where the abstracts were piled ceiling-high and shook his notes and graphs and charts into a neat four-inch stack and turned off thirty or fifty-three valves on the glass-pipe puzzle he'd been playing with, and went back home to sack out in his two-room tumbledown.

Somewhere after midnight he began to mumble, then he sat up, looked around, and ran to the lab, a mile and a half in flapping pajamas with the last autumn leaves skittering alongside him on the deserted street. Morning came and he was done, perhaps; everything was fizzing nicely, triple-distilled and four ways filtered, and he'd covered the blackboard with radicals and hydroxyls and sulfones. Of course, with grad students you never know, especially chemists, but when the department head's

secretary walked in at half-past-eight to pass out the morning memo, he sighted with his squirter and zapped her right on the ass to test, with proper scientific attitude, whether or not the stuff worked like it should. He'd dissolved his merry mixture in with some DMSO, which can carry things right through the skin into the old bloodstream where the action is, so you can bet that fresh-from-the-vat lovejuice zipped through skirt and skin faster than an unclean suggestion. The secretary, well, she jumped, and quivered, and seemed to sizzle for a few seconds. Then she threw all her papers up in the air and tackled *him* before they'd begun to fall. In the confusion, our hero must have forgotten what he had in his hand, because the next thing you know, there was another *Ssst*, another surprised sizzle, and more steam, and by nine-thirty the lab was strewn with broken glass all over the floor, and the two of them were bombing down the interstate in his Datsun, off on adventure, high on love, too high to be startled, too high to think, too high to care. And her a married woman.

Maybe you know a better way to plan your life.

As you can see, it worked. That's the way these things go. You didn't need the DMSO; you could eat it or drink it or smoke it or massage it in. It didn't matter. The damned stuff was a pheromone (that means chemical messenger, like skunk-spray, or musk) and a proximity catalyst, and it worked better than home cooking and candlelight. One dab, and the nearest, soonest breather to you, you fell in love with, ninety-eight times out of a hundred and three. The real thing! Weak-in-the-knees-and-soft-in-the-head love! If you stared at the formula carefully enough, you'd find this boondoggling tetra-hydro-cannabinol molecule wobbling in the wings, a coincidental hell raiser which got tacked on Boyle only knows how, but it meant you got pretty high for the first hour or so, which usually sent the two of you straight for the bushes, or from one end of the house to the other, rugs, chairs, counters and showers. None of this Platonic nonsense here, no way. Had he known, Plato would have been spinning in his grave, and Mr. Ortega y Gasset, too, but those philosophers were always rather gyroscopic, so what's a few more RPM?

Like any self-respecting magic potion, the spritz in question was nearly tasteless (peppermint, a hint), colorless, harmless (beyond the primary effect—although it did clear up sniffles), and, worst of all, cheap.

So what happened?

Friends, it was a redeemable ex-

perience. It was a dollar-a-quart. When the other grads got in later that morning, they saw the remains, tried it out, figured it out, and soon the whole hillside of Ithaca, New York was smiling, smirking, running around and generally spread-eagled more than any radical revolution ever saw. It was incredible! Nobody escaped! You'd be quietly studying when up would walk some lovely loon with an itch, then *Ssst!* you'd been scratched. Turn around, and *Fap.* That took out the afternoon, and the evening, usually, and you'd not be worrying too much for another week or three, although you'd have come down enough to get back to your work also. It was wild.

Well, it was a fun private thing for a while, but when heads started to clear, they realized what they had. Twenty-nine carat universal dynamite. No more *True Confessions.* No more Singles' Bars. No more frustrated cruisers. No more sexy ads selling after-shave. The whole schtick wiped clean. Bye-bye, American piety. But, they wondered, who would take responsibility? Who would patent? Who would produce? Who would control?

Inspiration, or maybe neo-radical dadaist anarchists, prevailed. One month of hush. The ominous calm. Then, *hel-lo!* in almost every newspaper and magazine, easy formulas, drawings, diagrams, recipes, suggestions and best wishes from the entire anonymous crew . . .

Total havoc? Not quite. But ah, that transmogrifying summer. Imagine the expression of that first National Guardsman as he headed his platoon along the pool to the steps of the youth-besieged Washington Monument. Rifle heavy in his hands, fresh-pressed uniform damp against his skin, he stands at the edge of the enemy's camp. The order comes: *get those kids out of there!* he advances. Everyone falls silent. One girl takes a step into the hot concrete band between them. Her long white legs seem to glow in the noon sun. A pale blue T-shirt clings gently to her skin. She faces our soldier boy, hands on hips—and calmly draws a water pistol.

Just take it from there and raise it a few powers of ten; it's all exponential for a good long while. A few professors were annoyed at not having deep social problems to discuss anymore, and there's no counting the thousands of shrinks, politicians, WCTU's, cops and counselors thrun out of work by this high-time pheromone. But nobody else seemed to mind; they rather preferred it, if you must know. So the economy went hoo-hah. That's happened before, and things have worked out. Actually, there was a bigger fuss about twelve years later when they isolated the RNA memory code groups for language segments and taught them to replicate in the tray.

Did industry run that one into the ground! It upside-downed the book industry, for one. Why read when you could eat? Faster, more nourishing. A stack of lecture note sandwiches and a homework cola. Best-sellers for people on diets. The paperback publishers merged with the fast food chains, and it wasn't long before you'd find yourself going down to the nearest McDonald's for a quick cheesethriller, order a Travis McGee and large fries, or maybe a Lew Archer to go, no Russian. And once the avant-garde writers began plotting their novels by shaking chapters together in the test tube—but that's not for a few more years. Our story concerns what's happening *now,* in the welcome awaited days of aerosol love.

So, in New York City, where five or eight years of push-a-button love have helped turn the old morgue-town into an almost livable Lindsayized city, we've got this pervert and this criminal. Or vice versa. There's some confusion, but anyway, it's their story, and that's most of what you need to know. Things aren't the way you remember them, naturally, but figure, all that love at large for so long, you gotta expect changes. You can't tell it from the real thing, so it becomes the real thing. Standard American plastic-transmogrified-into - accept - no - substitute - *eau - de - l'amour.* Yes, indeed. Just like that.

So we've got Ellen and Arnie, one's a pervert and the other's a criminal. It doesn't matter who's which. In fact, it doesn't matter who's what; they could both be boys or both be girls or one a chicken and the other an old shoe, so long as it's somebody else there to do the touching and not yourself. Here we got one boy, one girl, but you can pretend otherwise if you prefer. It doesn't matter; love is a steamroller and anybody who tries to stand in its way won't for long.

Pervert, you say? Criminal? In a finally nonhostile world, where emotional safety has wiped out the need for security in material possessions or the tantrumic smashing that cried out for love?

Pervert. Criminal. Arnie doesn't want love. He doesn't spray when he gets the itch, and nobody lovesprays Arnie. He packs a forbidden pillbox of antilovespray enzymes. Very hard to get, very expensive

THE ANALYTICAL LABORATORY/SEPTEMBER 1975

Place	Title	Author	Points
1.	Pro	*Gordon R. Dickson*	1.787
2.	The Killers	*Karl Hansen*	2.416
3.	The Restoration	*Gordon Eklund*	2.604
4.	Beyond Grayworld	*Gregory Benford*	2.852

when you can, very antisocial. And very effective. Once in the morning does it. No love for our boy Arnie. He's a real hard case.

Ellen? Even worse—*she* wants the real thing. What sort of nonsense did her parents bring her up on? No drug for her; she's an atavism and a freak like no other—an uncut romantic searching for true love. A real grail-hunter, her.

There was this party in the Village, and they both were there, not really listening to the music blasting or watching the ripple of the wallscreens. Most everybody ignored them, both long known for their weird-out ways, and they were gradually pushed to the same unwanted corner. Every so often some girl would walk up to Arnie, take his arm and scratch it with her love-me-bracelet as she looked him straight in the eyes, waiting for him to sizzle and scratch back, or spray, or whatever this particular cool would pack. But instead he'd stare right back at her, cool and cold, until she backed away, not quite understanding what hadn't happened, because it was as common as kissing and not everybody knew what it was all about anymore, but she wouldn't have to stay scared for long, because somebody would grab, spin and squirt her soon enough, and that would be that. She'd forget. Arnie kept breathing. Ellen was backing away from the center, staring at everybody and waiting, wanting that inner deafening bell to start tolling for her, when she backed a bit farther and bumped into Arnie. " 'Scuse," she said, and turned around. *Bong, clang, clong,* her eyes crossed and ears went red; melodramatic, yes, but weren't you once like that? Some things never change. She knew this was it, her one-and-only.

But Arnie, he was a none-and-lonely, something inside said, *Watch it;* when he heard that sizzle, he scrammed. Broken-field dodged across the room and out, heading for his Honda.

Ellen, behind, shaking herself awake, running, powered by the fires that roared in her ears.

Look, here comes Arnie now, biking up Broadway in his crinkle-brown leathers. The afternoon is blue and bright, with an unsmogged spring oozing from every direction. He hears a growing purr behind him, so he twists the throttle and swerves around a couple bare-assed in the street, under the hot spring sun. There goes Ellen, mad on his tail, trailing him with wild eyes and bared pointy-filed teeth grinning in her mind. Between her legs her trim Hodaka Wombat trail bike purrs and slaloms across the rocky Central Park paths like a jungle-musty-tigress. Crosstown and up again, *Rawrrr,* cutting through parading brass bands and past the hot dog vendors. Arnie is on the Avenue, passing the skaters at Rockefeller Plaza

and circling under the flags and fountain, then his neck chills and he kicks down on the clutch, leans against the bar and *Rrrmmms* away.

West to the Hudson River and up the Henry Hudson Parkway, Ellen comes upon him at Ninety-sixth Street and tally-hos. The afternoon-clear highway leads them under the shiny web of the George Washington Bridge and beyond. Arnie swerves off at the Cloisters exit, and Ellen smiles. *Off* the road she goes, and onto the gravel again, dodging trees and pulling her trusty trail bike through skids and turns and jumping *over and whoomp!* rev again and continue chase. Far ahead the road returns, *Rrrmmm*—he's just ahead of her! *Rawrrr,* she nudges the Wombat onto the road again. Arnie picks up another gear. But he's losing ground.

Then the road sheers, twists, ends; with a sickening tumble Arnie is gone over the side, disappeared, and suddenly silent. Ellen cries out. She rears up and stops short. *Somewhere down there—*

She sees a trail opening. The trees are lush, billowing like sails, deep green, burnt red, white gold. A fat crow calls to a gull. Beneath her helmet she shakes her head as if to toss back her hair, and charges through. Her abbreviated handlebars jerk back and forth as she weaves the rocky path down. The cliffside scrapes her heavy boots, and branches rake her goggles. The world comes in flashes: turn, twist, jump, go! The motor's

IN TIMES TO COME

The long-awaited third segment of Frank Herbert's *Dune* series—"Children of Dune"—will be the main feature of January's issue. Like "Dune" and "Dune Messiah," this is a massive novel filled with the richly-drawn characters and lovingly-detailed ecology of the desert world Arrakis. Because of its length, "Children of Dune" will be serialized in four installments, and the first installment will take up a major portion of next month's issue.

The Atreides twins are the title characters. Like all of Herbert's Duneworld characters, these two youngsters are unique people. They are the goal/result of the generations-long Bene Gesserit breeding program—children who were born with the *entire* memory of *all* their ancestors. So, although they are physically only children, they have all the knowledge of their whole line of forbears.

John Schoenherr has done a magnificent cover painting. (Incidentally, Schoenherr has done *all* the illustrations for every publication of the Dune stories—except for one book cover.)

The science fact article is by Henry Sauter, and tells how we can begin to use solar heating and wind power to ease our energy shortages—now.

Rawrrr and her blood's *Tsshhaaaa* and her hands and feet melt into the controls. A crumple of light and dark: there he is, agang and agley in the tumble of his steed. She runs to him, pulls him gently from the bent heap that leaped with him into the sky, and wonders if he is still alive.

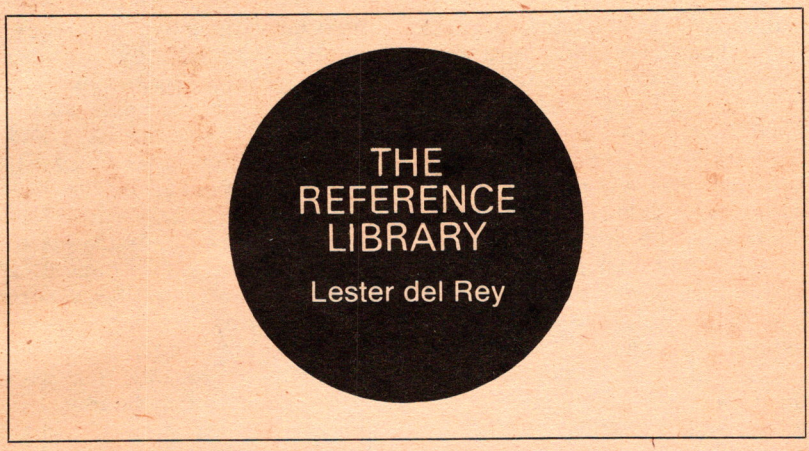
Arnie stirs, unclenching a fist that no longer holds a handle, and sees her. He tries to run, but he is down, caught, and cannot move. Over him, Ellen is crying, making a flooded fishbowl of her helmet, cradling him in her arms. He feels woozy, floating. His throat is too tight to speak, but he takes her hand. Here his pills will not work, but suddenly he doesn't want them to. The tightness within him releases, like a piano wire snapping, and he finds himself reaching up to her. *Clonk,* their helmets collide, like astronauts, or eggs. He reaches to the sides of her head, lifts off the hard plastic mask as she unsnaps his. It is funny. But that seems right, too. She is crying still, but with less sobbing, and he feels like he might cry also. He looks at the origamied Honda, and at the waving trees, and back at her, and she whispers, "Shh, it's all right now." And she leans down to kiss his lips, and he holds his breath, then kisses her, and the running is all over, because the large gray fear is burned away like morning fog, and there is nothing not to have, nothing to need. Ellen rocks back and forth with the bells clanging and the wind blowing in her hair. A lifetime later they get up, wave good-bye to the Honda, and *Rawrrr* slowly away on the Wombat. Under where they had lain remains a bent plastic sprayer, but it is just ever-present litter, like beer cans and gum wrappers, and is not noticed. If indeed it should be.

That's what happened, mostly, and they never quite figured it all out, but like with all cheerful things it didn't seem to matter much as long as it had happened. They shaped up and adjusted and soon they looked and seemed to act just like everybody else, which is, of course, the important thing.

So you see, it works out, even for perverts and criminals like them and you and me, so you can't get sick inside because someone else has it and you're still looking and waiting. Just keep your mind open, don't think too much, and don't jump sideways when that steamroller rolls over you.

But even so, isn't it better still that now we don't have to wait through all that pain; that now we don't have to bother with wrestling psyches and ductless gland games; that now a simple *Ssst* can do it for you, to you, the real swoon-and-moon thing? Hurrah for the pheromones, love for all and all for love. Simple as that.

Simple as that. ■



SF, SCI-FI—AND WHADAT

Every so often, I give in to an urge to be sociable and go to some evening affair where there will be a number of writers, editors and assorted sundry others. Just what the attraction of such things may be, I haven't quite figured out, but I still find myself going. I can't hear conversation by the time the decibels climb over the 120 mark; my ears refuse to separate out distinct sounds from the background. I don't really like paper cups for ashtrays, and I'm only half resigned to stepping over drunken or stoned bodies as I grope for the exit. But there's still that annoying social urge.

It's getting worse lately, however. They've added a new way of bugging me. There's a word or term that gets thrown around. The last time, it was a reasonably young woman who stood shouting in my ear and bracing her tottering self by clutching at my beard. "Oh," she cooed in a high and loud soprano, "I've read all your books, Mr. Ley. I just *love* sci-fi!"

Now I don't mind the lie about reading my books, because maybe she thought my ego needed a little boost. I don't mind her getting my name wrong, because I'm not very good with names myself.

But *sci-fi!*

There's something shoddy and debasing about the term. It rings with ugliness in my ears, though I'm not quite sure why it offends me so much. However, most of my science fiction friends seem to react the same way.

It's certainly an ignorant contraction—because it isn't properly a contraction at all. The *fi* in fiction is never pronounced as *fie.* And for anyone who cares, there is already an excellent short form—SF, which can be pronounced "essef" by anyone who finds four syllables too much effort.

Of course, sci-fi comes from a

bad analogy with another debased form, though not a distorted one. Once upon a time, there was something called high fidelity equipment; some was produced with skill and love by intelligent hobbyists, and the rest by small companies who labored mightily to overcome the limits of tubes, speakers and pickups. Then the idea of high fidelity sound began to have market value. A lot of slightly improved junk began coming out, all labeled as high fidelity, since there was no legal definition of the term. And the salesmen for the spurious equipment shortened the term to hi-fi, probably wisely deciding that anyone buying such equipment couldn't cope with hard words like fidelity, which those who tried probably pronounced with a long vowel in the first syllable. So hi-fi became a noun in time, and meant anything having maybe four tubes and a five-inch unbaffled speaker, selling for more than $25.

Anyhow, lately I've been considering sci-fi. And maybe there is some justification for its use. When enough people began talking about Brand X, Brand X went on the market. Now people are saying things about sci-fi. And behold, there's a lot of genuine sci-fi on the market. You must have seen it. It uses a few gimmicks from science fiction, some pretty bad writing, some gobbledegook, and often comes labeled as science fiction.

I think it's time the publishers of that sort of stuff should be honest and call it sci-fi. And behold, one publisher has already gratified my wish.

Next time you're at a book store, look for **Mandrill,** by Richard Gardner (Pocket Books, 208 pp., $1.25). Look on the spine at the top and you'll see the clear and honest warning label: SCI-FI. Thank you, Pocket Books, for never mentioning SF or science fiction on your cover or inside blurb! I freely forgive you for calling it "a chilling novel of man's space-born origins" having the "compulsive fascination of *Chariots of the Gods!*" Quite probably, for sci-fi readers, the blurb may be true.

In sum, it's the story of a man who sets up an experiment in communication with a mandrill—a relative of our more common baboons. He figures they communicate by facial gestures that a computer can analyze. So far, so good—and we've got the necessary science fiction gimmick to start it off. After which, it's sci-fi all the way.

He finds the key to mandrill language rather easily when he realizes that what his computer translates as "never" really should be Nefer-Tmu, a minor Egyptian god. Aha, the mandrill must be speaking ancient Egyptian! Now that should be obvious to anyone of the right mentality; the Egyptians worshipped animals, including apes—so presumably the mandrills learned their facial gestures from the Egyptian sounds. And with that remarkable insight, our hero (well, our protagonist, at least) begins getting into long conversations with our mandrill. His televised face is shown to the mandrill when he asks questions. Presumably because his ancestors came from Africa, he

has no trouble mastering the art of gesturing ancient Egyptian, though he still needs the computer to translate the mandrill's answers. Or maybe I've missed something—I only read it through once, and didn't see any footnotes.

Anyhow, the mandrill tells him (most fluently) that evolution is bunk; every type of life that exists has always existed, except one. Being a good scientist, he immediately sees through the Darwin hoax and spends long arguments telling his Asian female co-worker that Darwin was wrong. I wasn't convinced; but apparently she had not already heard the arguments over and over from illiterates, so she agrees with him. Then he finds out about the "except one" bit. Man is fairly new. Some millennia back, a spaceship landed and aliens got out. They either mated with apes or just survived, and we're their descendants. (He's thrilled by this novel idea.) He justifies it with a few quotes from von Däniken, including the Nazca lines. (Look up a good picture from the air of those lines sometime. The drawers used the ground as a palimpsest without ever erasing, and it's a hodgepodge that could be anything you want.)

Then there's the added gimmick of a space mission approaching a planet in Cygni-61. A science fiction gimmick again. But there is no mention of faster-than-light communication, though there's continual two-way television communication between them and Earth. Maybe they use face gestures, and such things go faster than light?

Anyway, along with such excitement and chilling fascination, we get the human story. Our hero has three others sharing the novel. There's a neurosurgeon who gets his kicks by torturing his subjects during experiments, or at least thinking about it. He's a baddie. There's a gal who formerly used our hero in horizontal games and now gets her kicks remembering how she seduced her father. And there's an Asian girl who kills her mother just to be kind. In the end, our hero kills the first two and is killed by the mandrill, who had previously been on excellent terms with him. Fade out as the Asian girl gets set to communicate with the mandrill and learn the big secret which I thought we'd already learned.

That is definitely sci-fi, just as the label says. Look for yourself—look, but don't buy.

Then there's the "whadat," which could probably be called science fiction if one wants to stretch the term enough. Occasionally, a sample of that kind is so darned good and has somehow so much of the feeling of science fiction that it's well worth stretching the term.

The Chalk Giants, by Keith Roberts (Putnam's, 195 pp., $6.95) is obviously laid on Earth some time in the future, following what was an atomic catastrophe. The first section shows this. Monkey is pulled around in a little cart by two human survivors, Pru and Sal. They avoid the places that used to be cities, but Monkey's curiosity

forces him to invent a way to go into such a ruin.

This is a curiously moving bit. Keith Roberts can write marvelously, and he can carry the reader into the story and into the frame of his characters without seeming to try. Monkey is a genius in many ways, capable of teaching himself to read. And somehow, Roberts makes it believable. It's a bitter, wrenching sketch of the world after everything has been ruined, seen from eyes that try to understand but cannot.

From there on, the book might almost—but not quite—be a series of historical sketches. Somehow, however, we know that this is a beginning again, not a looking back. Some time after the episode with Monkey, we find the beginnings of organized primitive life and religion, depicted in all the ugliness of both, yet with a sympathy that makes them real and a part of us all.

The stories carry on, each slightly related to the others before, by some connection with a symbol marked on the chalky cliff, from which the book gets its title. History is telescoped drastically, as if relearning were much easier than the first slow efforts of mankind. And by the time we come to the fifth and final episode, we've reached a sort of feudalism, and gunpowder has been re-invented.

Maybe it's a parable of the nature of man and progress. Maybe it isn't science fiction. But it's the sort of book only science fiction readers would appreciate—and perhaps that's really what makes a book science fiction. The writing is far above what one usually finds in any category, and the characterizations are splendid.

Forget what it is. Just read it.

Then there are books that are clearly labeled science fiction or SF, and which can't be anything else. Whether you like that kind of science fiction or not, you won't be fooled by the label or the blurbs on **Eye of the Zodiac,** by E. C. Tubb (DAW Books, 176 pp., $1.25).

This is #13 in the Dumarest saga. Most of these books have had a woman's name as the title and have been based on Dumarest's experience with some important woman—sexual or otherwise; oddly, while there are two women mixed up in his affairs this time, neither is major enough to justify naming as a title. Anyhow, in a way this is sort of a breakthrough in the saga.

At the time of these books, man has spread throughout space, heading toward the center of the Galaxy. Earth is remembered in a few legends, but everyone is sure there never was such a place. Dumarest knows better, however. He was born there. He left as a child, lost all direction as he moved from world to world, but now wants to return. His problem is to find some clue that will guide him back. He works his way in all kinds of jobs and missions from sun to sun, but so far his quest has been fruitless. In fact, it has endangered his existence; a semi-religious group based on a computer made up of linked brains has learned that he has a se-

cret they badly need, and they now chase him to gain his brain and the knowledge it contains. Since they are powerful on many of the worlds, their danger is ever-present.

It isn't a bad situation (though it could become hackneyed if misused). But how can 13 such books keep any interest? Much to my surprise, Tubb has managed it by a variety of planets and situations into which Dumarest gets, and by quite good characterization. It's something like the fascination of the Howard sword-and-sorcery stories, though Dumarest is no dumb barbarian.

This time Dumarest befriends a fellow-worker, to find that he came from a place called Nerth. The boy dies eventually, but Dumarest keeps trying to discover his origin—since Nerth just might be a contraction of New Earth; surely in such a place, some clue to the ancient world must remain.

Eventually, Dumarest is able to trace the boy back to his home. What he finds there isn't at all what he'd hoped or expected. But this time he does find a clue that may guide him back to Earth. I'm delighted at that. It's about time the series developed some evidence, and I'm glad Tubb realized it.

Good adventure. The whole series has been fun to read.

And for a real "whadat" there's a book that is maddening enough that I can't resist it. **The Dreamtime,** by Robert Louis Nathan (Overlook Press, 280 pp., $8.95) is not at all science fiction, and it's a strange kind of fantasy, if I can even call it that. If you like your fiction simple and clear, avoid it. But if you are willing to sort out a loose tangle of threads and follow them one by one to where they are woven together, try this. Some of the hardiest new wave readers should find it fascinating, I'd guess; it's sort of a big overall symbol of faith, progress, and the ways of a Messiah and those who follow.

In this case, the Messiah came 3,500 years ago in the western part of Australia. We follow him, sometimes out of order, and we see his effect on a tough-minded British sailor more than a century ago. We also get a man ruined by gas in World War I. He is seemingly telling the story from a diary of an uncle. But that's not consistent, since neither could have known much of the story. Neither is the background, unless you think there were wolves, wildcats, and bats in Australia back then. But there is some marvelous description and considerable excellent magic. There's also some excellent writing—and some that is downright bad in spots. But somehow it proved fascinating to me.

I'm glad I read it. Maybe you will be, but I promise nothing.

And just to keep things well mixed up and in need of labels, there's a book which is simply labeled "Fiction" on the spine, but which is something that is becoming fairly common; it's a suspense story where the world is endangered by some catastrophe that might be used in a science fiction story. Some of these make fairly

good reading and a few have used enough SF ideas well enough to make them slightly more than borderline science fiction. One, entitled *Mutant 59*, was done by the authors of this latest novel. But **Brainrack,** by Kit Pedler and Gerry Davis (Pocket Books, 254 pp., $1.50) is far over the border on the wrong side, toward sci-fi.

This time—in the future, slightly—scientist Mawn discovers with the aid of a woman scientist that what he thought was a bad interface between man and computer is actually some mysterious affliction that is gradually eroding the intelligence of a great many people. Our computers are now often in the hands of men without the mental power to use them—even though those men were once brilliant. In searching for the cause, he discovers that such flawed minds are responsible for a big nuclear power plant using a new method. There are some excellent action and suspense scenes when the plant breaks down while he's testing there. (And some bits that I find quite unconvincing.) But then he gets back, finds the answer to the deteriorating mental ability in a—you guessed it—chemical from automobile exhausts.

This time, the authors seem more intent on writing a tract against technology as a threat to the future than a novel. Their hearts are in the right place. Too bad their heads weren't on the story content. They've done much better in the past.

Isn't it about time more honest SF was printed and less of the rest of it? ■

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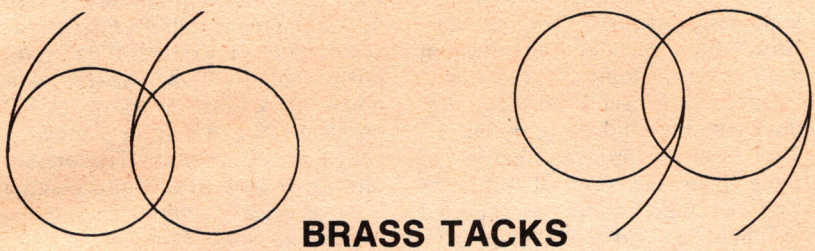

BRASS TACKS

Dear Mr. Bova:

I was surprised by your treatment of Professor J.A.Hynek in your generally sensible Editorial "None So Blind" (June 1975). Yes, I know you didn't mention him—*that* was your treatment. Now, I outdo Asimov in believing that "well-rotted horse manure" describes not only Velikovskyanism, but also astrology, Dänikenomania, Uri Gelleritis, Creationism, etc. And, like you, I consider myself an adherent of scientific method in these matters. But—

(1) I do not see why this requires you to lump the UFO problem with all the unscientific nut-ologies ("the UFO-astrology-Fundamentalist kinds of beliefs," etc.). The opinion that there are "flying objects" (or aerial phenomena, etc.) which are as yet "unidentified" has nothing necessarily to do with the nuts or their "contactee" entrepreneurs. You understandably suffer from a revulsion against the nut-cult that has grown up around this unsolved problem, in the pattern of the "cargo cult," but the fact of the cult speaks neither for nor against any hypothesis on the scientific issue.

(2) The opinion that there is a real UFO problem is not identical with the view that some UFO's are operated by an intelligence, or are of extraterrestrial origin, or both. To be sure, the latter is a valid hypothesis; but there are other possibilities, including Hynek's non-ET view. In any case, one should not assume exactly what has to be investigated.

(3) The emphasis you placed on your Texas incident is lamentable. You must know that a multitude of "sightings" have been debunked through investigations by the scientific "UFOlogists" (Hynek, NICAP, APRO, etc.). Your selected incident would not hold up against two minutes' worth of questioning by them.

(4) Your view of the decisive importance of the "Hill/Fish map" is grossly exaggerated, as your own words show. You say that if the star map "holds up," you will become an adherent of sorts of the

"UFO believers," but if it "can be shown to be nothing more than a random coincidence," then the ET hypothesis suffers "another setback." Both parts of the statement are weak in logic. As you say, "some experts feel almost any random pattern could be reproduced." *That* issue is probably harder to settle than the original problem. The star map cannot be expected to "hold up" like the map in a buried-treasure tale. All you are saying is that, if the random-coincidence hypothesis proves strong, then the Hill/Fish map is not hard evidence one way or the other.

(5) Your central point is the rhetorical question, "Where is the evidence. . . ?" Fine. But the uninformed reader may assume you are saying that only the nuts purport to offer evidence. The briefest answer to your question is: See the book, *The UFO Experience,* by the only scientist who was engaged for a quarter century as the Government's official investigator of the UFO problem, in the Air Force's Project Bluebook. That's where Hynek comes in. I should also mention the NICAP and APRO people and other investigators who are at least as scientifically disposed as thee and me, but some unjustly consider them as somehow less "respectable." I have not seen these efforts recognized as worthy of mention in Analog, whether in the book review, Editorial, or science fact sections.

I have a challenge. You opened your pages to the Velikovsky debate; good. Was it because the AAAS itself gave it respectable sanction by debating it? The UFO issue was also so honored. (See *UFO's: A Scientific Debate,* edited by Carl Sagan and T. Page.) The year before, a Congressional committee solicited and heard testimony by scientists on the UFO problem. (See *Aliens in the Skies,* edited by J.G. Fuller.) The presentations before the Congressmen were as scientific-minded as in the AAAS; no nuts. This isn't a bibliography. I am indicating why it is surprising that you take no account of the following fact: *There is now a considerable body of eminently scientific literature which answers your rhetorical question.* Since the "discreditment" of the Condon report—which was designed to put UFO's outside the pale of scientific respectability but accomplished the reverse, by backfiring like the Watergate break-in—there has been a growing wing of (sniff) "UFOlogy" that is strictly based on scientific canons of inquiry and evidence.

I suggest that Analog open its pages to a reasonable debate on this evidence, within the framework of the scientific method—sternly excluding the nuts as well as the "scientists" who say they wouldn't believe it if a UFO landed on the front lawn. I suggest that the issue be formulated *Resolved, that there is sufficient scientific ground to justify a large-scale scientific, unbiased investigation by an uncommitted scientific task force.* Note that the issue to be decided is *not* the ET hypothesis, though it will be a component of the debate. For this hypothesis, or any other, cannot be confirmed one way or the other

without an investigation, such as has not yet taken place. The controversial issue is not "faith" in one dogmatic answer or another, but willingness to take the problem seriously as a subject of scientific inquiry. It is clear that the establishment says no, with Carl Sagan as the softest tip of the nay-sayers. I do not propose that Analog take a position, but only that it provide a forum for a debate that sane, scientific-minded people can respect.

PAUL VREELAND
Albany, California

Challenge declined. If there's one thing that the Velikovsky "debate" proved, it's that most people have their minds made up and won't listen to another point of view, except to attempt to refute it. The UFO controversy needs no new scientific investigation, anyway. It's been well-established that most UFO sightings are unusual, but perfectly natural phenomena. The unexplained sightings are simply those for which there is too little information to provide a solid factual basis for an explanation. To date, there has been no (repeat, NO) valid evidence for extraterrestrial visitations. Would that there were!

Dear Mr. Bova:

In your June 1975 issue both your editorial, "None So Blind," and the "Brass Tacks" department contain discussions of what can be called the Faith versus Reason Argument. Both yourself and Isaac Asimov seem to be defenders of the classical rational-positivistic-linear mode of thought which has dominated the Western mind since the years following the Italian Renaissance. This is unfortunate.

Since Western culture (beginning with the probable year of composition of Homer's *Odyssey*) has been going for some three thousand years, Linear Rational Positivism has had a relatively short domination over the Western mind: namely a little under four centuries. It is quite narrow of Asimov to claim that this is the only way for Western (and, by implication, Eastern and African) Man to think. It is obvious that Asimov loathes any deviation from his own form of mental discipline, but as for myself, I find the Rational-Positivist paradise which the eminent doctor and his colleagues created for this country and the world during their heyday (late Forties to early Sixties) to be a flawed one, to put it mildly. Thus, a madman like

Air Force Officers receive instruction on UFO's!

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Velikovsky is a refreshing relief.

To begin with, as Will Durant suggests at the close of his *Our Oriental Heritage,* "science" may be only another Western religion, like Judaism, Olympianism, Druidism, or Christianity. When an Asimov denounces astrology or *I Ching* because their teachings cannot be reduced to the "one plus two equals three" level, he is displaying a mulish authoritarianism, totally opposed to the only true, *humanly* useful goal of *any* kind of inquiry: namely, human freedom. If one studies the original writings of the Age of Reason—(Voltaire, Rousseau, Bacon, Newton, or, if you wish, even back to Galileo), one immediately discovers a lot more than Rational Positivism; one discovers that these men were all motivated by a desire to free themselves from what they considered to be impingements on their freedoms, both mental and physical. In their case, they substituted the prevailing faith of the Church with a faith of their own; but now the time has come to overthrow the tyranny of Rational Positivism. Only a computer—as opposed to a free man—would want to think in terms of "one plus two equals three."

Astrology and the *I Ching* deserve more consideration from the scientific community because they predate rational science as a means of understanding *humanity's* position in the universe: the *I Ching* subtitle, "Book of Changes," alone is worth considering since it accurately describes what this country and the rest of the world is undergoing. Moreover, there is a *communal* aspect to these disciplines; you can't throw the *I Ching* coins by yourself—it must be done with another person or persons, whereas it takes only one man to look through a microscope. Do you see the difference? The *I Ching* makes us look at each other and recognize each other, as do many other disciplines which presently fall under the unfortunate label of "occultism." This so-called occultism has given us the recognition of each other, whereas Rational Positivism has given us only machines.

ROY TROXEL
227 Clement Street
San Francisco, California 94118

Why is it, then, that there was so little change in the human condition between Aristotle's time and Francis Bacon's? And why such an immense leap forward—in human freedom, wealth, and dignity—since the scientific method revolutionized European life? Only machines, huh? It was the steam engine that ended human slavery, not mysticism or humane essayists. If it weren't for all those machines, both you and I would be breaking our backs on subsistence farming, friend, if we had been lucky enough to survive into adulthood. You can have the I Ching: *I prefer the Periodic Table of the Elements.*

Dear Mr. Bova:

I enjoyed your Editorial in the June Analog, "None So Blind." A healthy but openminded skepticism is a good scientific attitude. Your description of "The Zeta Reticuli Incident" prompts this letter. There are several weak points in Mrs.

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Hill's reconstruction of the flying saucer star map. One, of course, is the actual correspondence of the purported map with known star maps of terrestrial origin, and I should think this would be a major problem.

The weakest link in this story, however, is the recovery of this kind of detailed memory under hypnosis. It doesn't happen. I know we have all heard anecdotes about detailed memories recovered during hypnosis, but there is no real evidence for this kind of hypermnesia. Hilgard, in *Annual Review of Psychology*, 1965, quotes the few legitimate studies of this phenomenon. In one study young adults who could not remember early teachers and classmates were able to remember some of them under hypnosis. The memories could be checked against school records. This is interesting but it is an entirely different kind of memory recovery from the accurate reproduction of an unfamiliar map after only a brief exposure. There is no evidence of that kind of accurate memory reproduction under hypnosis and no reason to assume that it exists.

If the star map is accurate, this can be taken as absolute evidence that the whole thing is a hoax . . .

J. Eric Holmes, M.D.
Associate Professor of Neurology
University of Southern California

Or is it that people "remember" what they want to?

Dear Ben:

Mr. Lester del Rey in his The Reference Library column for Analog, June 1975, entitled, "War of the Sexes," is entirely right about women breaking into print.

Why not? We are all human beings together, aren't we? I consider a well-written story is a well-written story is a well-written story, whether it's done by a man or a woman. I have read some great stories by women in both fiction and nonfiction, especially science fiction. Some of them can produce even better than men, though some real diehard male readers still don't think so . . .

James W. Ayers
609 First Street
Atalla, Alabama 35954

One basic problem with women writers, however, is that they often confine themselves to "feminine" topics—which restricts their reading audience unduly, especially in science fiction.

EDITORIAL

continued from page 8

other technique involves centrifugal separation of the two isotopes.

A third possibility is to use a laser beam to separate the U235 isotope from the U238. Tunable lasers can produce the precise wavelength of laser energy to excite the U235 atoms in a gaseous mixture of U235/U238. The U235 atoms are ionized by the laser energy, while the U238 atoms are not. The ionized atoms can be collected by conventional mass spectrometer techniques, and then used to enrich fuel samples at a fraction of the cost of the gaseous diffusion methods.

This technique was developed, and demonstrated, at Avco Everett Research Laboratory nearly five years ago. Avco and Exxon Corporation formed a jointly-owned organization to push this new technology further. Their aim is to make laser-driven uranium enrichment a profitable venture. Success will mean much cheaper enriched uranium, and the slight but real possibility of obviating the need for the breeder reactor.

When news of their success was announced publicly, it caused hardly a ripple in the technical press, and was roundly ignored in the public press. Perhaps this suited Avco and Exxon; too much premature publicity frightens corporate executives.

But in 1974, two AEC-sponsored laboratories—at Livermore and Los Alamos—announced similar achievements in laser isotope separation. And the full power of the government's publicity machine splashed the story through the technical, trade, and public news media. In none of these releases was the previous work at Avco mentioned. None of the newspapers and magazines picked up on the earlier Avco/Exxon announcement. Only the *Wall Street Journal,* in a followup story in May 1975, connected the government labs' work with the earlier success of the Avco/Exxon team.

"Not invented here" is a dangerous attitude among scientists and their administrators. The next step is to convince yourself that since your group didn't invent it, it hasn't been invented at all. Closed eyes lead to closed minds. Or perhaps *vice versa.*

An even bigger snub arose when KMS Fusion, Inc., announced it had succeeded in creating a pulsed thermonuclear fusion reaction, using lasers (again!) to implode microscopic-sized pellets of deuterium.

Since the end of World War Two, the governments and universities of the world's major nations have struggled to make a fusion reaction. For most of this time, they tried to produce a continuous fusion reaction in a star-hot plasma of deuterium that was suspended in one form of "magnetic bottle" or

another. None of these attempts has worked. The ionized plasma always leaks through the containment of the magnetic field and ruins the experiment.

About five years ago, when lasers began to achieve the power levels necessary to trigger fusion reactions, several AEC laboratories started efforts in laser-induced pulsed fusion. So did KMS Industries, Inc. Their subsidiary, KMS Fusion, accomplished what Livermore and Los Alamos and all the world's best fusion scientists failed to accomplish: KMS produced fusion reactions.

The bureaucracy hinted mightily, once the news was out, that KMS was wrong. That the experiments were inconclusive. That the data was too scanty to be believable.

Over the past year, the weight of scientific evidence has proved that KMS is indeed making fusion reactions. The scientists examined KMS' data and agreed that it was valid. The bureaucrats finally capitulated by giving KMS a modest government contract to produce data on laser-pellet interactions.

Thankfully, in science it's the data that counts. Not opinions. Not official attitudes. Not press releases.

By early 1975 it had become painfully evident that the old AEC "game plan" was not scoring for anyone. The entire lemminglike march from gaseous diffusion plants to breeder reactors slowly ground to a halt. The Atomic Energy Commission officially reorganized into the Energy Research and Development Agency. ERDA's chief is Dr. Robert Seamans—a scientist and administrator who comes, significantly, not from the nuclear research community (as AEC's leaders did) but from the rather successful world of missiles and space exploration. One of Seaman's first actions has been to recommend a slowdown on breeder development, because of its enormous potential environmental threat, and more emphasis on solar energy research.

It would be curious if the laser fulfilled the original promise of the atom. Laser-driven isotope separation plants might make it possible to provide enriched uranium for power plants without the necessity of deploying breeder reactors and playing Russian roulette with extremely dangerous plutonium. Laser fusion might end energy shortages forever, and could begin to make an impact well before the end of this century.

But none of this will happen if the nuclear bureaucracy is allowed to continue its old ways. That attitude has resulted in mammoth public resistance to nuclear power plants, and poor technical decisions based on obsolete ideas.

The broken promise of nuclear energy can be mended and made bright and shining again. But only if we insist on it.

THE EDITOR

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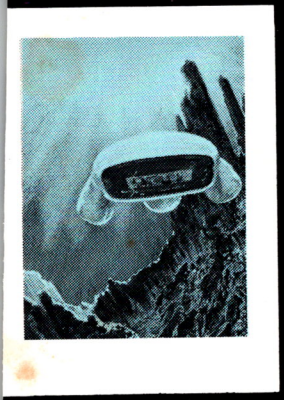

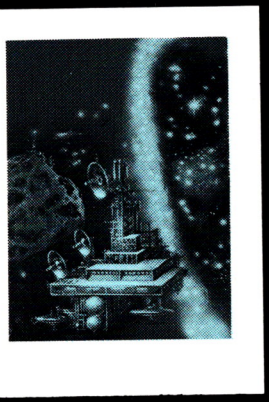

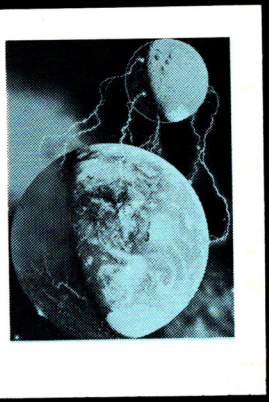

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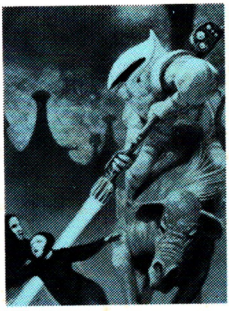

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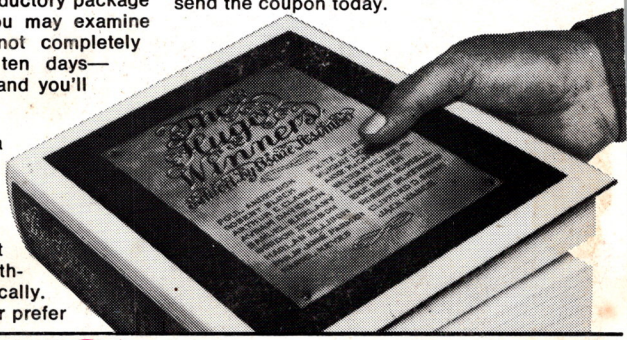

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